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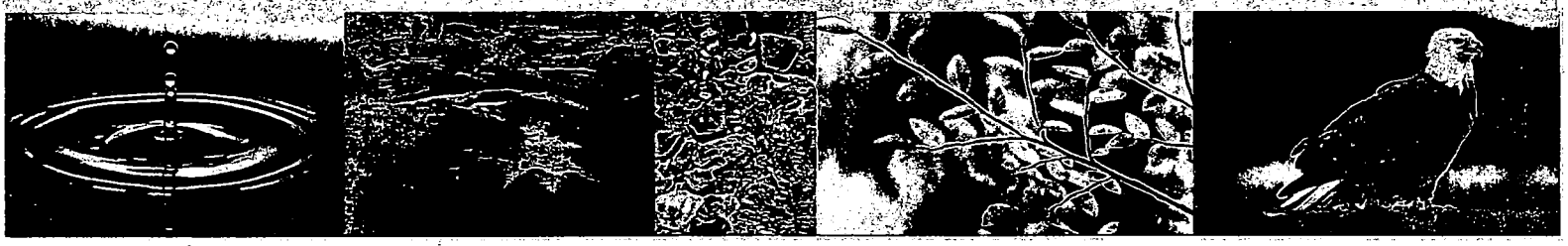
WORK PLAN FOR ELECTRICAL RESISTANCE HEATING TREATABILITY STUDY SITE 22
NS GREAT LAKES IL
4/7/2006
TETRA TECH

Comprehensive Long-term Environmental Action Navy

596

CONTRACT NUMBER N62467-04-D-0055



Rev. 0
04/07/06

Work Plan
for
Electric Resistance Heating Treatability Study Site 22

Naval Station Great Lakes
Great Lakes, IL

Contract Task Order 0009

April 2006

NAVFAC
Naval Facilities Engineering Command
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

TETRA TECH NUS, Inc.

REVISION 0
APRIL 2006

WORK PLAN
FOR
ELECTRIC RESISTANCE HEATING TREATABILITY STUDY
SITE 22
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

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CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 0009

APRIL 2006

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LIST OF ACRONYMS AND ABBREVIATIONS

cis-1,2-DCE	cis-1,2-dichloroethene
cVOC	Chlorinated volatile organic compound
dB	Decibels
ERH	Electrical Resistance Heating
FS	Feasibility Study
HASP	Health and Safety Plan
Illinois EPA	Illinois Environmental Protection Agency
LUC	Land Use Control
NAVFAC EFD SOUTH	Naval Facilities Engineer, Field Division South
NS	Naval Station
PCE	Tetrachloroethylene
PCI	Pollution Control Industries, Inc.
PCU	Power control unit
PVC	Polyvinyl chloride
QAPP	Quality assurance project plan
QA/QC	Quality assurance/quality control
RI/RA	Remedial Investigation/Risk Assessment
scfm	Standard cubic feet per minute
TCE	Trichloroethene
TMP	Temperature monitoring point
TRS	Thermal Remediation Services, Inc.
TtNUS	Tetra Tech NUS, Inc.
UIC	Underground Injection Control
VC	Vinyl chloride
VR	Vapor recovery

1.0 INTRODUCTION

This Electric Resistance Heating (ERH) Treatability Study Work Plan has been prepared for Site 22, former Building 105 Old Dry Cleaning Facility, at the Naval Station (NS) Great Lakes located in Lake County, Illinois. The plan has been prepared under the Comprehensive Long-Term Environmental Action Navy IV, Contract Number N62467-04-D-0055, Contract Task Order 0009. The purpose of this Work Plan is to provide details on the ERH treatability study and the associated sampling and waste management activities.

The groundwater and soil sampling associated with this work plan will be conducted in accordance with the Quality Assurance Project Plan (QAPP) for NS Great Lakes (revised June 2003) and specifically Appendix IX, which was prepared for the Remedial Investigation and Risk Assessment (RI/RA) at Site 22. The QAPP presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the Site 22 - Building 105 Old Dry Cleaning Facility at NS Great Lakes. Specific protocols for sampling, sample handling and storage, chain of custody, and laboratory and field analyses are also described. The June 2003 QAPP also incorporates the Health and Safety Plan (HASP) for the site; the HASP has been updated to include additional requirements for these activities and is presented in Appendix A.

The Navy is implementing this treatability study with a team including representatives from the Illinois Environmental Protection Agency (Illinois EPA), Naval Facilities Engineering Field Division Southern (NAVFAC EFD SOUTH), the Navy's consultant Tetra Tech NUS, Inc. (TtNUS), and the NS Great Lakes Environmental Department.

1.1 FACILITY AND SITE BACKGROUND

NS Great Lakes (see Figure 1-1) covers 1,632 acres of Lake County, Illinois. Lake County is located in northeastern Illinois, north of the City of Chicago, and comprises 24 miles of Lake Michigan shoreline. Lake County extends from the Wisconsin border south to Cook County and from Lake Michigan west to McHenry County. Lake County is divided into 18 townships, 52 incorporated cities and villages, and 18 unincorporated cities and villages.

NS Great Lakes administers base operations and provides facilities and related support to training activities (including the Navy's only boot camp) as well as a variety of other military commands located on base. There are a variety of land uses that currently surround NS Great Lakes. Along the northern

boundary of the base are the most highly urbanized and industrial areas. Much of the land beyond the northwestern site boundary comprises unincorporated lands of Lake County and lies vacant except for scattered retail and residential properties. Adjacent to the western boundary are primarily industrial properties; while along the southern boundary is a mixture of public open space and residential land (TtNUS, June 2003).

Site 22 is bounded on the south by Porter Street, on the west by a vacant asphalt-paved lot, on the north by Bronson Avenue, and on the east by Sampson Street (see Figure 1-2). The former building was a slab-on-grade structure measuring approximately 150 feet by 70 feet. The former 10,500-square foot building occupied a lot measuring approximately 250 feet by 115 feet. NS Great Lakes (U.S. EPA # IL7170024577) has operated with Resource Conservation and Recovery Act (RCRA) interim status authorization since November 19, 1980. Building 105 was originally included in a RCRA Part A permit that has been modified over the past 25 years.

Building 105 was constructed in 1939 and was utilized as a dry cleaning facility until 1993 or 1994 when it was converted to a vending machine supply and repair station. From 1993 or 1994 until February 2001, the building was used to warehouse and repair vending equipment and products. The vending machine supply and repair operations ceased in February 2001, and the building was vacant until it was demolished in March 2003.

The RCRA unit in Building 105 (SO1) consisted of a drum storage area located inside along the eastern wall. Hazardous waste consisting of spent tetrachloroethene (PCE) from the laundry facilities was stored in this area from 1980 until 1987. The maximum quantity of waste stored at this unit is unknown; however according to the revised RCRA permit, 165 gallons (three 55-gallon drums) was the maximum amount of waste stored at one time in this area. The storage area consisted of the concrete floor (no berms or curbs were present) of the building adjoining the concrete block exterior wall. Near the storage area, two cracks and construction joints were observed in the concrete floor, as well as a garage-type entry door and several floor drains. Historic building foundation plans show the floor drains were connected to the storm sewer system located outside of the building. No visual evidence of spillage (staining) was observed or reported in this area, and the floor was in good condition in February 2003 as indicated in the Remedial Investigation and Risk Assessment (RI/RA) report (TtNUS, 2004).

The building foundation plans also show two 6-inch drains from the gutter under the washing machines associated with previous laundry operations. These drains were connected to a grease catch basin located outside the southeastern corner of the building by a 6-inch cast iron pipe (see Figure 1-2). The grease catch basin was approximately 5 feet by 7.5 feet by 5.5 feet deep with two chambers and had a

6-inch tile effluent pipe. It is speculated that the effluent line from the grease catch basin was connected to the waste water (sanitary) lines for NS Great Lakes. It is postulated that the soil and groundwater contamination is from this part of the dry cleaner operations.

1.2 TREATABILITY STUDY DESIGN BASIS AND OBJECTIVES

ERH will be utilized for the treatabilty study. In this technology, the vadose zone and saturated soil are heated via an electric current passed between subsurface electrodes. As the current warms the soil, a portion of the soil moisture boils and becomes steam. The target contaminants also evaporate and are carried with the steam to be recovered via a vapor recovery (VR) system. More information on the ERH system is presented in Section 2.0.

In general, the treatability study is designed based on information presented in the site RI Report (TtNUS, July 2004) and Feasibility Study (FS) (TtNUS, 2006), and subsequent groundwater and soil sampling data (Baseline Sampling Work Plan, TtNUS, presented in Appendix B). The purpose of this treatability study is to significantly reduce the mass of chlorinated volatile organic compounds (cVOCs) in the source area and to determine the design parameters for a full-scale implementation of ERH, if necessary. The following sections will provide more details on the design data and study objectives.

1.2.1 Treatability Study Location and Depths

The locations and depths of the study area were determined based on the data obtained as part of the site RI and during baseline sampling conducted in November 2005. The area was selected because it encompasses the suspected contaminant source area and addresses areas known to contain PCE concentrations greater than 20 milligrams per kilogram (mg/kg); 20 mg/kg represents the goal for the final average cVOC concentration following treatability study activities (Section 1.2.2). Figure 1-3 is included to graphically present the locations and approximate results of the samples utilized to determine the ERH area.

The treatability study will be conducted in a 2,400 square foot area near the southeast corner of former Building 105, extending east to Sampson Street. Inside this area, three distinct depth intervals will be treated: the northeast corner will be treated to a depth of 25 feet; the remainder of the eastern portion will be treated to a depth of 18 feet; and the western portion of the area will be treated to a depth of 8 feet (Figure 1-4).

Based on calculations performed as part of the FS and recent data showing low concentrations in surface soil outside of the ERH study area, the area included in the treatability study will address the vast majority of cVOC mass on site.

1.2.2 Treatability Study Treatment Objectives

As stated above, the goal of the treatability study is to reduce the average cVOC concentration of samples collected from the treatment area to below 20 mg/kg. For the purposes of this study, cVOCs are considered to be the sum of the concentrations of PCE, trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC). The 20 mg/kg represents a reduction of 95.5 percent from the pre-remediation sample data; the pre-remediation sample data include samples from the baseline sampling event (Section 2.1) and historical sample results. The samples collected to confirm this reduction will be collected from the same approximate location and depths (15 samples) as the pre-remediation samples. The pre-remediation sample data are summarized in Table 1-1; the locations of the samples are shown in Figure 1-5.

The percent reduction obtained via ERH will be calculated as follows. As shown on Table 1-1, the cVOC concentrations for the 15 samples were averaged to provide the PRE-REMEDIATION average cVOC concentration (445,315 mg/kg). In order to calculate the percentage reduction obtained by ERH, samples will be collected from these same locations and depths (15 samples) following remediation and the POST-REMEDIATION average cVOC concentration will be calculated in the same manner as the baseline. The following calculation will be used to determine the percent reduction:

% reduction = (445,335 mg/kg - POST-REMEDIATION average CVOC conc.) / (445,335 mg/kg)

Other objectives for the treatability study include determining the potential effectiveness and overall costs of implementing a full-scale system, if necessary, and potentially, reducing concentrations at the site sufficiently to allow implementation of a closure plan that incorporates Land Use Controls (LUCs) for the soil and groundwater at the site.

1.2.3 Project Team Organization

TtNUS has been contracted by the Navy to perform the ERH Treatability Study that is described in more detail in Section 2.0. TtNUS has subcontracted Thermal Remediation Services, Inc. (TRS) to provide, install, and operate the equipment for this study. The table below provides a summary of the roles and responsibilities of TtNUS and TRS during this project.

Task	TtNUS	TRS
Determine treatability study location and depths	Lead	NA
Design of ERH wells and equipment layout	Review	Lead
Coordination with Navy for utility location and work approvals	Lead	Assistance as required
Drilling for electrode and TMP installation	Lead, Subcontract TTL for drilling	Oversight
ERH system design, permitting, installation	Review and oversight	Lead
Vapor recovery and treatment system	Review and oversight	Lead
ERH system shakedown and start-up	Oversight	Lead
ERH system O&M, vapor sampling, and weekly reports	Oversight	Lead
Interim and confirmatory soil sampling	Lead	NA
Demobilization and site restoration	Oversight	Lead
Waste disposal – coordinated with NS Great Lakes personnel	Lead, Subcontract PCI	Assist with spent carbon reactivation
Final ERH treatability study report	Lead	Provide data as required

TABLE 1-1

PRE-REMEDIATION SAMPLE DATA
SITE 22 - BUILDING 105 DRY CLEANING FACILITY
NAVAL STATION GREAT LAKES, ILLINOIS

Sample No.	Depth (feet bgs)	PCE (a) (mg/kg)	TCE (b) (mg/kg)	cis-1,2-DCE (c) (mg/kg)	VC (d) (mg/kg)	Total CVOCs (e) (mg/kg)
NTC22SB20	6 - 7	26,000	ND (f)	ND	ND	26,000
NTC22SB21	9 - 10	9,300	1,800	5,800	ND	16,900
NTC22SB21	13 - 14	160,000	10,000	13,000	ND	183,000
NTC22SB22	7 - 8	19,000	ND	ND	ND	19,000
NTC22SB22	18 - 19	200,000	ND	ND	ND	200,000
GL95-105S-13	2.5 - 3	1,500,000	ND	ND	ND	1,500,000
NTC22MW05S	0 - 1	190,000	ND	ND	ND	190,000
GL95-105S-12	0 - 0.5	370,000	ND	ND	ND	370,000
GL95-105S-12	2.5 - 3	600,000	ND	ND	ND	600,000
NTC22SB19	19 - 20	570,000	5,600	9,300	ND	584,900
TOL01-GP04	8 - 12	550,000	ND	820	ND	550,820
NTC22MW10D	9 - 11	130,000	1,300	1,700	ND	133,000
NTC22SB15	0 - 1	770,000	7,700	52,000	ND	829,700
NTC22SB15	11 - 12	590,000	ND	ND	ND	590,000
NTC22MW06D	7 - 8	870,000	7,300	9,100	ND	886,400
AVERAGE		**436,953**	**2,247**	**6,115**	**ND**	**445,315**

Notes:

(a) PCE - Tetrachloroethene
(b) TCE - Trichloroethene
(c) cis-1,2-dichloroethene
(d) VC - Vinyl chloride
(e) CVOCs - Chlorinated volatile organic compounds (PCE, TCE, cis-1,2-DCE and VC)
(f) ND - Non-detect

P:\GIS\GREATLAKES_NTC\APRS\BLDG105.APR SITE LOCATION MAP 5/24/05 AJ

DRAWN BY: K. PEILA	DATE: 12/2/03	SITE LOCATION MAP SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY NAVAL STATION GREAT LAKES, ILLINOIS	CONTRACT NUMBER: N00078
CHECKED BY: R. YOUNG	DATE: 5/25/05		APPROVED BY: RFD — DATE: 5/25/05
COST/SCHEDULE-AREA			APPROVED BY: — — DATE: —
SCALE: AS NOTED		NAVFAC	DRAWING NO.: FIGURE 1 - 1 — REV: 0

P:\GIS\GREATLAKES_NTC\APRS\BLDG105.APR SITE MAP 5/26/05 AJ

DRAWN BY: K. PEILA	DATE: 12/2/03	SITE MAP SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY NAVAL STATION GREAT LAKES, ILLINOIS	CONTRACT NUMBER: N00078
CHECKED BY: R. YOUNG	DATE: 5/25/05		APPROVED BY: RFD — DATE: 5/25/05
COST/SCHEDULE-AREA			APPROVED BY: — — DATE: —
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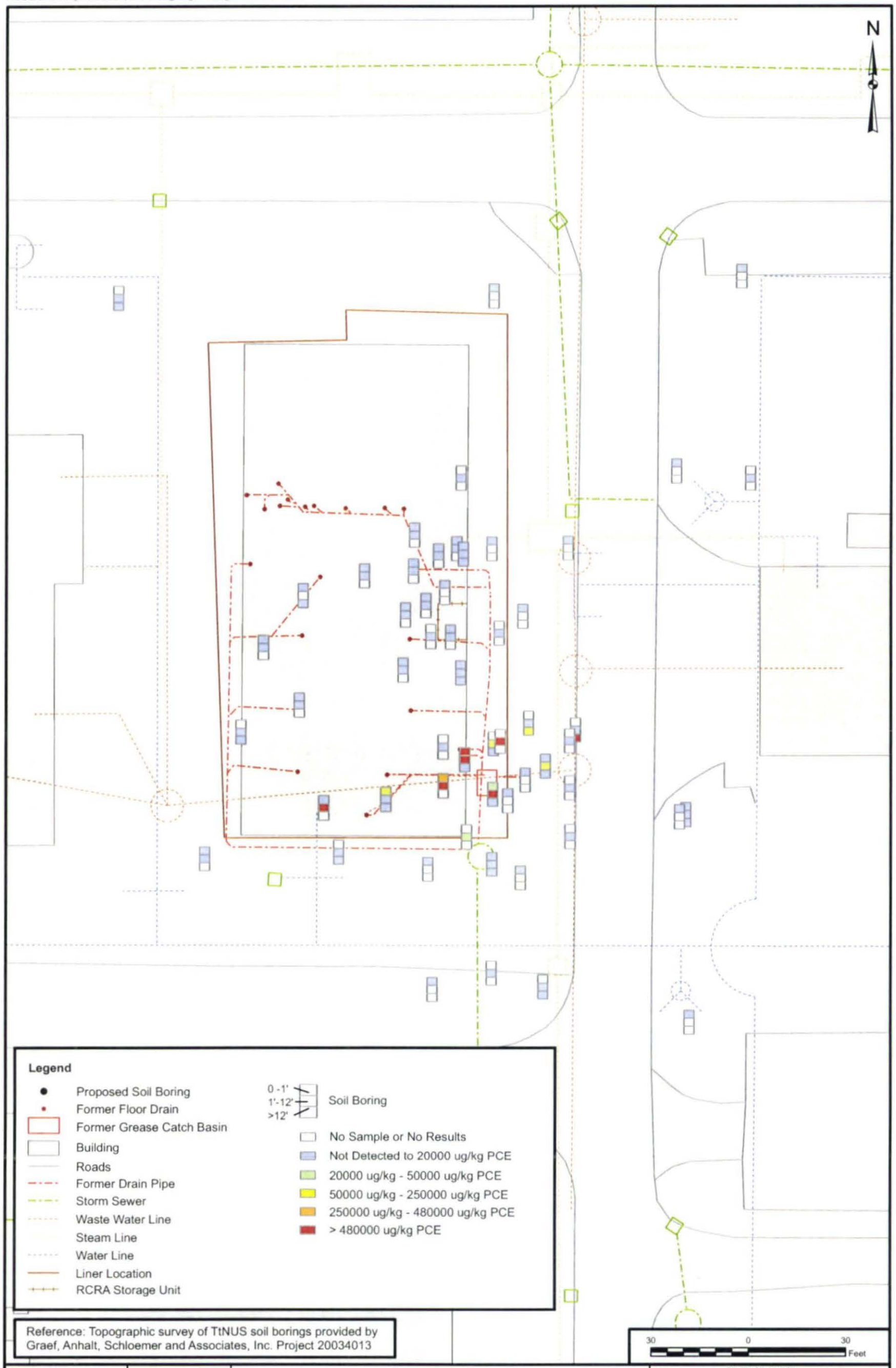

DRAWN BY: C. SPEHAR	DATE: 10/13/05
CHECKED BY: C. PIKE	DATE: 4/7/06
REVISED BY: ___	DATE: ___
SCALE: AS NOTED	

NAVFAC

CURRENT SOIL SAMPLE DATA
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY
NAVAL STATION
GREAT LAKES, ILLINOIS

CONTRACT NUMBER: 00202	
APPROVED BY: RFD	DATE: 4/7/06
APPROVED BY: ___	DATE: ___
FIGURE NO: FIGURE 1 - 3	REV: 0

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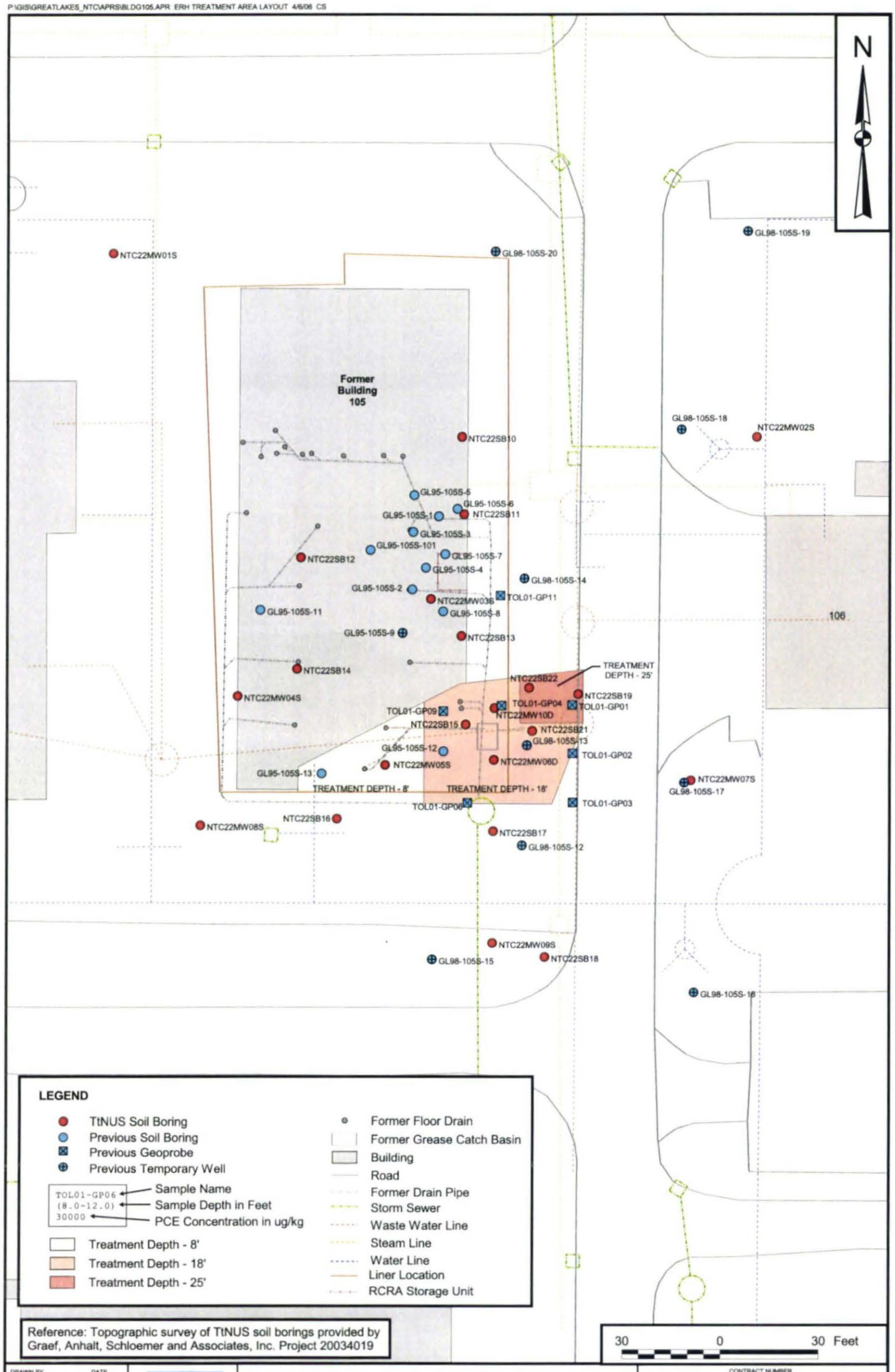

DRAWN BY: C. SPEHAR	DATE: 1/4/06	ERH TREATMENT AREA AND DEPTHS	CONTRACT NUMBER: 00202
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COST/SCHEDULE-AREA		NAVAL STATION	APPROVED BY: — DATE: —
SCALE: AS NOTED	NAVFAC	GREAT LAKES, ILLINOIS	DRAWING NO.: FIGURE 1 - 4 REV: 0

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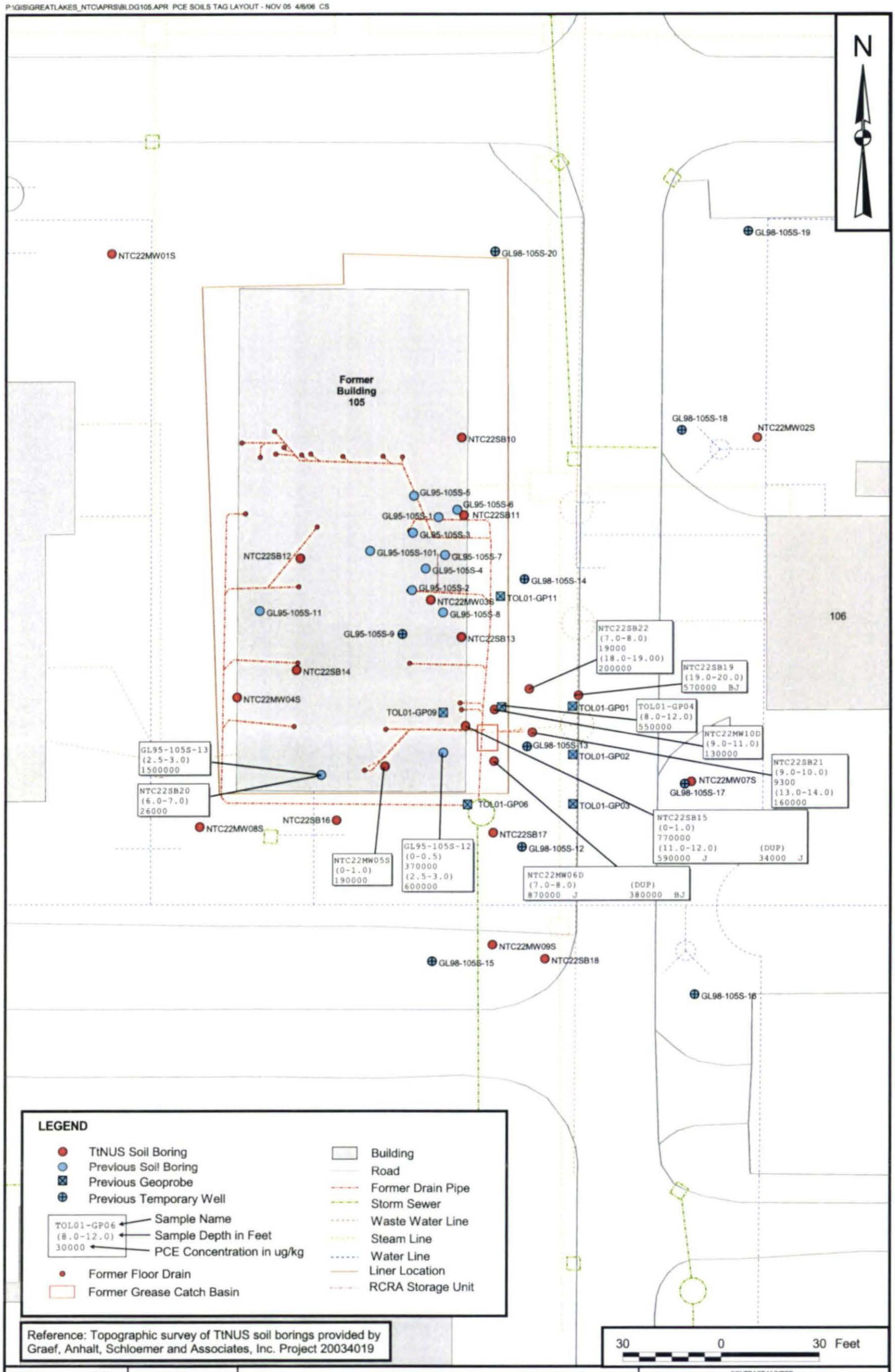


Reference: Topographic survey of TtNUS soil borings provided by Graef, Anhalt, Schloemer and Associates, Inc. Project 20034019

DRAWN BY: C. SPEHAR — DATE: 1/4/06	PRE-REMEDIATION SOIL SAMPLE RESULTS FOR PCE	CONTRACT NUMBER: 00202
CHECKED BY: C. PIKE — DATE: 4/7/06	SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY	APPROVED BY: RFD — DATE: 4/7/06
COST/SCHEDULE-AREA	NAVAL STATION	APPROVED BY: — DATE: —
SCALE: AS NOTED	GREAT LAKES, ILLINOIS	DRAWING NO.: FIGURE 1 - 5 — REV: 0

NAVFAC

2.0 WORK APPROACH

As stated above, TtNUS has subcontracted TRS to provide and operate the equipment for this ERH treatability study. A description of the work approach for the project is presented in this section. Additional details regarding the portions of the project subcontracted to TRS are presented in their Design and Work Plan, which is included as Appendix C.

The execution of the project includes various tasks, including:

- Baseline Sampling (completed)
- ERH system installation
- ERH system start-up and operation
- Interim soil sampling
- System shut down and confirmatory sampling
- Waste management
- Reporting

2.1 BASELINE SAMPLING

In November 2005, TtNUS conducted baseline soil and groundwater sampling to determine the optimal extent of the ERH pilot study and provide data for evaluation of the effectiveness of the study in reducing cVOC concentrations at the site. The work was conducted in accordance with the Baseline Sampling Work Plan attached in Appendix B of this document and Appendix IX of the QAPP, Field Sampling Plan, and Health and Safety Plan (TtNUS, 2003). The baseline sampling event included collection of eight samples to either delineate or provide further data in the projected ERH area and six surface and near surface samples to determine the presence of contamination in areas outside the ERH area. The sample results from the baseline sampling event are summarized in Table 2-1.

The six samples from outside the ERH area showed that little contamination remained in surface areas outside the suspected source area that had previously exhibited high cVOC concentrations. This was believed to be due to construction activities associated with the demolition of Building 105 and installation of the parking lot in the area.

Five of the eight samples collected inside the projected ERH area contained detectable concentrations of cVOCs; these samples were combined with ten historical soil samples to provide the pre-remediation data

set to which post-treatment confirmatory samples will be compared. This data set is presented in Table 1-1 and the sample locations are shown in Figure 1-4.

Additionally, groundwater samples were collected from four of the site monitoring wells in the treatability study area to provide information on pre-treatment conditions. These sample results are summarized in Table 2-2.

Complete information regarding the baseline sampling event (including laboratory analytical data, boring logs, and sample log sheets) will be presented in the ERH Treatability Study Report that will be submitted following completion of the study.

2.2 ERH SYSTEM INSTALLATION

Following mobilization to the site, the subsurface components of the system will be installed. Prior to installation of the subsurface components, TtNUS will work with the appropriate NS personnel and the Illinois One-Call system JULIE to locate underground utilities and confirm that these utilities will not be affected by the ERH activities. Additionally, a fence will be erected around the entire study area to prevent unauthorized access during installation and operation. The fence will have "DANGER – HIGH VOLTAGE" signs prominently displayed throughout its perimeter. Additional security will be provided for the ERH PCU via key-lock doors on the PCU enclosure.

Subsurface installation will include:

- 16 ERH electrodes
- Three temperature monitoring points (TMPs)
- Electrical service from the nearby electrical switch to the ERH Power Control Unit (PCU).

The design and locations of the electrodes and TMPs are included Appendix C. TtNUS, along with TRS, will oversee the installation of these components. TRS will utilize a subcontractor who has experience at the NS for installation of the required electrical components.

Concurrent with the subsurface installation procedures, the groundwater monitoring wells in the ERH treatment area (NTC22MW05S, NTC22MW06S, NTC22MW10S, and NTC22MW10D) will be abandoned per Illinois EPA protocol. This is necessary because the high temperatures generated in the area would be expected to destroy these polyvinyl chloride (PVC) wells. Three abandoned wells (NTC22MW06S, NTC22MW10S, and NTC22MW10D) will be re-installed in their present locations and to their present

depths following the treatability study. Contamination has not been detected in NTC22MW05S in the two sampling events for this site; therefore, this well will not be replaced following the study.

Management of the soil cuttings generated during the subsurface installation is described in Section 2.6.

Following installation of the subsurface components, the surface piping and wiring will be connected to the ERH equipment as described in Appendix C.

Prior to start-up of the system, applicable permits requirements will be met. Based on initial discussions with the Illinois EPA, permit requirements include completing the substantive portions of the permits below for review and approval by the Illinois EPA:

- An underground injection control (UIC) permit to allow a portion of the recovered pore water to be recirculated to the electrodes to make sure that the backfill of the electrodes borehole remains moist; and

- An air permit from the Illinois EPA Bureau of Air to allow discharge of vapors from the VR system and the ERH cooling tower.

2.3 ERH SYSTEM START-UP AND OPERATION

Following installation of the equipment and piping, system start-up will be performed. A detailed description of the start-up procedures is included in Appendix C. An important aspect of the start-up will be making sure that the noise requirements of NS Great lakes are met at the nearby receptors (the barracks located across Porter Avenue and the fire station across Sampson Street). In addition to a soundproof enclosure and silencers placed on the blower inlet and outlet, additional measures will be taken if the nighttime sound requirement of 60 decibels (dB) is not met immediately upon start-up. These measures could include construction of additional, insulated wooden enclosures around the loudest equipment.

Following start-up, system operation visits will be made weekly during initial operation and bi-weekly after that period. System monitoring data such as electrical input, subsurface temperatures, and vapor flow rates will be monitored remotely on a daily basis. Remedial progress will be tracked via cVOC removal calculations based on samples collected from the recovered vapor stream during system operation. Sampling frequencies and parameters are included in the Sampling and Analysis Plan that is an attachment to TRS' Design and Work Plan (Appendix C). The results of the vapor stream analyses will

also be utilized to determine the need for change-out of the activated carbon to meet permit requirements.

TRS will be responsible for the day-to-day operation of the ERH system; TtNUS will provide oversight and periodic on-site inspections. Specific performance metrics to be analyzed during operation are detailed in Section 6.2 of Appendix C. Weekly reports of system data will be prepared and submitted to the Navy and the Illinois EPA.

2.4 INTERIM SOIL SAMPLING

When it is determined that the ERH system is approximately 70 percent complete in reaching the treatability study objectives, an interim soil sampling event will be conducted. During this event, soil samples will be collected from the pre-remediation sample locations (Figure 1-5) and depths (15 samples) and analyzed for PCE, TCE, cis-1,2-DCE, and VC. The soil samples will be collected using the TRS hot soil sampling procedure. Excess soil from the sampling activities will be returned to the soil boring.

The laboratory analytical results for this sampling event will be obtained from the laboratory on a one week turnaround. The results will be analyzed to determine the progress made to date in reaching the study objectives in various portions of the study area. The study will be terminated if the objectives have been met throughout the study area (with VR continued for a period of approximately one week to recover residual vapors in the subsurface). If not, the remediation will be focused in areas requiring additional remediation, and the current applied to areas that have reached the goal will be ceased. This will allow more efficient and focused remediation during the final stages of the study.

Because the soil will be heated, care must be taken in the collection of these soil samples. TRS has developed a hot soil sampling procedure that will be followed. The procedure is included in Appendix C. In addition to these procedures, soil and groundwater samples that are part of the interim and confirmatory sampling activities will be collected in accordance with the QAPP for NS Great Lakes (revised June 2003) and specifically Appendix IX, which was prepared for the RI at Site 22.

2.5 SYSTEM SHUT DOWN AND CONFIRMATORY SAMPLING

When the cVOC concentrations in the recovered vapor from the VR system indicate that remediation is complete, the soil heating will cease. The VR system will operate for approximately one week after completion of soil heating to recover residual vapors. Following system shut down, the following activities will be completed:

- The electrical feed to the system will be properly de-energized.

- Above grade equipment and materials will be removed from the site.

- The electrodes and TMPs will be removed from the subsurface and the boreholes abandoned in accordance with Illinois EPA protocol.

- The surface of the parking lot and other areas affected by the treatability study will be restored to match the pre-existing conditions.

- Signs will be placed around the study area for a period of several months warning that the subsurface soil is hot and the NS Great Lakes Environmental Department should be consulted prior to conducting intrusive work in the area.

Within one month of shut down, the confirmatory sampling event will be conducted. During this event, soil samples will be collected from the same approximate locations and depths as during the interim sampling event; however, samples will not be collected from locations that exhibited non-detect concentrations of cVOCs during the interim sampling. At these locations, the non-detect concentrations will be used in calculating the percent reduction in cVOC concentrations.

The soil samples will be collected using the TRS hot soil sampling procedure. Excess soil from the sampling activities will be returned to the soil boring.

The soil cVOC concentrations from the confirmatory sampling (and, as appropriate, the interim sampling) will then be averaged, and the percent reduction in soil cVOC concentrations will be calculated using the equation presented in Section 1.2.2. The results of the calculation will be used to determine if the primary objective of the treatability study (95.5 percent reduction of average cVOC concentrations) has been achieved.

Following a period of at least one month to allow the soil to cool, three of the monitoring wells (NTC22MW06S, NTC22MW10S, and NTC22MW10D) abandoned prior to ERH system operation will be re-installed in their present locations and to their present depths following the treatability study. These wells will then be sampled via low-flow sampling methods to determine reductions in groundwater cVOC

concentrations achieved during ERH system operation. Soil cuttings from the monitoring well installation will be placed in 55-gallon drums for sampling and analysis and off-site disposal.

2.6 WASTE MANAGEMENT

Several waste streams will be generated throughout the installation and operation of the ERH system and associated sampling. The objective of this section is to facilitate proper storage, transportation, and disposal of these waste streams. The waste disposal operations will be coordinated through the appropriate NS Great Lakes personnel and will be completed in accordance with the Hazardous Waste Management Plan for NS Great Lakes (ACOS, 2002).

TtNUS will utilize NS Great Lakes-approved vendors and disposal locations for the disposal of the appropriate waste streams and the spent activated carbon will be regenerated off-site by the supplier of the activated carbon. TtNUS will prepare the waste profile/approval forms and manifests/shipping papers. These documents will be forwarded to NS Great Lakes personnel for approval and signature. Waste streams containing F002 waste will be removed from the site within 90 days of generation. The area in which the wastes will be temporarily stored will be inside the fenced remediation area; this area will be inspected regularly to confirm proper waste storage and labeling.

The management of each of the waste streams is detailed below:

- *Soil cuttings from installation of the electrodes and TMPs.* As the soil cuttings are generated, they will be temporarily stored in a roll-off box staged on site. The waste will be transported to Pollution Control Industries, Inc. (PCI) and disposed of as listed F002 waste. It is expected that up to 10 tons of soil will be generated.

- *Decontamination water from electrode and TMP installation.* This water will be placed in a 55-gallon drum awaiting off-site disposal as F002 waste or if it is not contaminated based on laboratory analysis, it will be added to the recovered pore water for disposal at the end of the project. Approximately 50 gallons of decontamination water are expected.

- *Recovered pore water.* cVOCs will be removed from this water as it is circulated through the condenser and cooling tower as part of the ERH process (Appendix C). This water will either be re-injected into the electrode borings (with approval from the Illinois EPA) as needed. At the completion of the ERH activities, up to 3,000 gallons of water will be disposed of off-site by PCI. Advanced Waste Services, Inc. will be the transporter of this waste.

- *Recovered vapor.* Vapor will be recovered from the subsurface at a rate of approximately 130 standard cubic feet per minute (scfm). This vapor will be treated, as necessary, via activated carbon prior to discharge to the atmosphere. Treatment and discharge of this vapor will be agreed to by the Illinois EPA as part of the permit process described in Section 2.2.

- *Spent activated carbon from the ERH process.* Spent activated carbon from the vapor treatment process will be transported as an F002 waste off-site by the carbon vendor (USFilter) to the USFilter Westates Carbon Arizona, Inc. facility for reactivation. Approximately 8,000 pounds of spent carbon will be generated.

- *Soil from interim and confirmatory soil sampling.* The small volume of soil produced from these sampling events will be placed back in the boreholes.

- *Soil cuttings from monitoring well re-installation.* The soil from the monitoring well installation will be placed in 55-gallon drums for temporary on-site storage awaiting off-site disposal. Because these cuttings will be generated following treatment, it may be advantageous at that time to sample the cuttings to determine if they are "clean" and would not be considered F002 waste. A sample will be collected from these cuttings for laboratory analysis. At the time of generation of this waste and based on the laboratory analysis, TtNUS, in conjunction with the Navy and the Illinois EPA, will determine the appropriate course of action for management of this waste.

- *Purge, decontamination, and development water generated from the interim and confirmatory sampling.* This water will be placed in 55-gallon drums for temporary on-site storage awaiting off-site disposal. In a manner similar to the soil cuttings above, the appropriate course of action regarding this water will be determined at the time that it is generated.

2.7 REPORTING

During operation of the ERH system, TRS will generate weekly status reports. These reports will include data from the ERH operation such as: vapor flowrate and concentration, estimated cVOC mass removal, electrical input, soil temperature profiles, volume of water generated, etc. The report will also detail any issues arising during the week and recommendations for actions to be taken during the upcoming weeks. These reports (in conjunction with interim soil sampling data, when received) will provide the basis for decision making during system operation.

Following completion of system operation, confirmatory sampling activities, and final waste disposal, TtNUS will submit an ERH Treatability Study Report. The report will include:

- A complete description of the baseline, interim, and confirmatory soil and groundwater sampling events. This will include a description of sampling methodology, tabular summary of soil and groundwater analytical data, tag maps, laboratory analytical data, boring logs, and sample log sheets.

- A description of the ERH system as installed and operated.

- A summary of data from the TRS weekly reports including estimates of total energy applied to the subsurface and total cVOC mass removal.

- A calculation of cVOC percent reduction and mass removal based on the baseline, interim, and confirmatory soil sampling.

- A comparison of the calculated percent reduction to the treatability study objective.

- A description of the waste management process including volumes of soil, spent carbon, and water disposed off-site. Appropriate manifests will be included as an appendix to the report.

- Recommendations for future activities at the site.

2.8 SCHEDULE

A detailed schedule of the ERH installation and operation activities is presented in the TRS Design and Work Plan (Appendix C). The anticipated schedule for major activities required for this treatability study is provided below:

- Baseline Sampling – completed in late November 2005
- Mobilize to site and begin ERH installation – 17 April to 5 May 2006
- ERH Start-up – 8 May to 12 May 2006
- ERH Operation – 13 May to 6 July 2006
- Interim Soil Sampling – Mid- to late-June 2006
- ERH Demobilization/Site Restoration – 10 July to 21 July 2006

- Monitoring Well Re-installation and Confirmatory Sampling – Late August 2006
- Final Report – November 2006

TABLE 2-1

BASELINE SAMPLING EVENT RESULTS - SOIL
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY
NAVAL STATION GREAT LAKES, ILLINOIS

Sample No.	Rationale for Sample Location	Depth from Surface (feet)	Depth from Top of Native (feet)	PCE (a) (mg/kg)	TCE (b) (mg/kg)	cis-1,2-DCE (c) (mg/kg)	VC (d) (mg/kg)	Total CVOCs (e) (mg/kg)
NTC22SB200203	Confirm historical concentrations at GL95-105S-13	6 - 7	2 - 3	26,000	ND (f)	ND	ND	26,000
NTC22SB200506	Delineate depth at historical boring GL95-105S-13	9 - 10	5 - 6	ND	ND	ND	ND	ND
NTC22SB2102	Provide additional baseline data in remediation area	8 - 9	1 - 2	9,300	1,800	5,800	ND	16,900
NTC22SB210405	Provide additional baseline data in remediation area	11 - 12	4 - 5	160,000	10,000	13,000	ND	183,000
NTC22SB211112	Provide additional baseline data in remediation area	18 - 19	11 - 12	ND	ND	ND	ND	ND
NTC22SB220203	Provide additional baseline data in remediation area	9 - 10	2 - 3	19,000	ND	ND	ND	19,000
NTC22SB220708	Provide additional baseline data in remediation area	14 - 15	7 - 8	ND	ND	ND	ND	ND
NTC22SB221112	Provide additional baseline data in remediation area	18 - 19	11 - 12	200,000	ND	ND	ND	200,000
NTC22SB230102	Confirm historical surface sample at GL95-105S-8	4 - 5	0 - 1	400	ND	ND	ND	400
NCT22SB230203	Confirm historical surface sample at GL95-105S-8	6 - 7	2 - 3	1200	ND	ND	ND	1,200
NTC22SB240102	Confirm historical surface sample at GL95-105S-2	5 - 6	1 - 2	720	ND	ND	ND	720
NTC22SB240203	Confirm historical surface sample at GL95-105S-2	6 - 7	2 - 3	1,200	ND	ND	ND	1,200
NTC22SB250102	Confirm historical surface sample at GL95-105S-10	5 - 6	1 - 2	2,800	ND	ND	ND	2,800
NTC22SB250203	Confirm historical surface sample at GL95-105S-10	6 - 7	2 - 3	ND	ND	ND	ND	ND

Notes:

(a) PCE - Tetrachloroethene

(b) TCE - Trichloroethene

(c) C[illegible]-dichloroethene

(d) VC - Vinyl chloride

(e) CVOCs - Chlorinated volatile organic compounds (PCE, TCE, cis-1,2-DCE and VC)

(f) ND - Non-detect

TABLE 2-2

BASELINE SAMPLING EVENT RESULTS - GROUDWATER
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY
NAVAL STATION GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Location Sample/Duplicate Sample Date	**Illinois TACO Groundwater Ingestion Criteria**	NTC22MW05S SAMPLE 8/11/2003	NTC22MW05S DUPLICATE 8/11/2003	NTC22MW05S SAMPLE 11/22/2005	NTC22MW06S SAMPLE 10/21/2003	NTC22MW06S SAMPLE 11/20/2005	NTC22MW06S DUPLICATE 11/20/2005
Chlorinated Volatiles (ug/L)							
CHLOROMETHANE		1 U	1 U	1 U	2000 U	1400 U	1400 U
CIS-1,2-DICHLOROETHENE	70	1 U	1 U	1 U	2000 U	1400 U	1400 U
TETRACHLOROETHENE	5	0.58 J	0.55 J	1 U	59000	45000	43000
TRICHLOROETHENE	5	1 U	1 U	1 U	2000 U	1400 U	1400 U
VINYL CHLORIDE	2	1 U	1 U	1 U	2000 U	1400 U	1400 U

TABLE 2-2

BASELINE SAMPLING EVENT RESULTS - GROUDWATER
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY
NAVAL STATION GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Location Sample/Duplicate Sample Date	**Illinois TACO Groundwater Ingestion Criteria**	NTC22MW10S SAMPLE 10/25/2003	NTC22MW10S SAMPLE 11/20/2005	NTC22MW10D SAMPLE 10/24/2003	NTC22MW10D SAMPLE 11/20/2005
Chlorinated Volatiles (ug/L)					
CHLOROMETHANE		1 U	2 U	0.21 J	1 U
CIS-1,2-DICHLOROETHENE	70	2.6	52	1 U	4
TETRACHLOROETHENE	5	62	3.5 J	8.9	1 U
TRICHLOROETHENE	5	1.3	2 U	1 U	1 U
VINYL CHLORIDE	2	1 U	2 U	1 U	1.3

J = Positive result is estimated as a result of a value below the reporting limit or a technical noncompliance.
U = Value is a nondetected result as reported by the laboratory and should not be considered present.
Shaded cells exceed the Illinois TACO Groundwater Ingestion Tier 1 criteria and Federal MCLs

TABLE 2-3

SAMPLE LOCATIONS, DEPTH, AND INTENDED DATA USE
INTERIM AND CONFIRMATORY SAMPLING EVENTS
SITE 22 – BUILDING 105 OLD DRY CLEANING FACILITY
NAVAL STATION GREAT LAKES, ILLINOIS

Sample Location	Sample Depth Interval(s)	Analytical Parameters	Number of Samples	Intended Data Use
Interim and Confirmatory Soil Sample Locations				
NTC22SB20	6' – 7'	cVOCs[1]	1 per event[2]	Interim soil sample data compared to pre-remediation data to determine if study objectives have been met or to determine appropriate additional ERH activities. Confirmatory soil sample data compared to pre-remediation data to determine if the study objectives have been met.
NTC22SB21	9' – 10', 13' – 14'	cVOCs	2 per event	
NTC22SB22	7' - 8', 18' – 19'	cVOCs	2 per event	
GL-95-105S-13	2' - 3'	cVOCs	1 per event	
NTCMW05S	0' – 1'	cVOCs	1 per event	
GL-95-105S-12	0' - 1', 2' - 3'	cVOCs	2 per event	
NTC22SB19	19' – 20'	cVOCs	1 per event	
TOL01-GP04	8' – 12'	cVOCs	1 per event	
NTC22MW10D	9' – 11'	cVOCs	1 per event	
NTC22SB15	0' – 1', 11' – 12'	cVOCs	2 per event	
NTC22MW06D	7' - 8'	cVOCs	1 per event	
Groundwater Samples – Confirmatory Sample Event				
NTC22MW06S	NA	cVOCs	1	Compare data to pre-remediation data to determine reductions in groundwater cVOC concentrations.
NTC22MW10S	NA	cVOCs	1	
NTC22MW10D	NA	cVOCs	1	
QA/QC Samples				
Soil Duplicates	--	cVOC	2 per event	QA/QC samples.
Groundwater Duplicates	NA	cVOC	1 per event	
Field Blank	NA	cVOCs	1 per event	
Trip Blank	NA	cVOCs	1 per event	
Rinsate Blank	NA	cVOCs	1 per event	

(1) cVOCs – Chlorinated volatile organic compounds that will be analyzed for as part of this scope include PCE, TCE, cis-1,2-DCE, and VC. The analytical method is SW-846 8260B.
(2) If samples are non-detect in the interim sampling event, samples from these locations will not be collected during the confirmatory sampling event.

REFERENCES

ACOS Installation & Environment, October 2002. Hazardous Waste Management Plan (Including Non-Hazardous Special Wastes), Naval Training Center, Great lakes, Illinois.

Illinois Environmental Protection Agency (Illinois EPA), October 2004. TACO (Tiered Approach to Corrective Action Objectives). Illinois Environmental Protection Agency, Bureau of Land, available at http://www.epa.state.il.us/land/taco/, accessed online, May 2005.

Naval Station Great Lakes, September 2003. Memorandum of Agreement between the Illinois Environmental Protection Agency, the U.S. Environmental Protection Agency, Region 5, and the U.S. Department of Navy. Ground Water Use Restrictions. September 30.

Tetra Tech NUS, Inc. (TtNUS), June 2003. Quality Assurance Project Plan, Site 7 - RTC Silk Screening Shop, Site 17 - Pettibone Creek & Boat Basin, Remedial Investigation & Risk Assessment, Naval Training Center Great Lakes, Great Lakes Illinois.

TtNUS, July 2004. Remedial Investigation and Risk Assessment Report – Site 22 – Old Dry Cleaning Facility, Naval Training Center Great Lakes, Great Lakes Illinois.

TtNUS, January 2006. Feasibility Study Report, Site 22, Building 105, Old Dry Cleaning Facility, Naval Station Great Lakes, Great Lakes Illinois.

U.S. Environmental Protection Agency (U.S. EPA), 1984. Groundwater Protection Strategy, Office of Groundwater Protection, U.S. EPA, Washington D.C.

U.S. EPA, May 1996. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Office of Solid Waste and Emergency Response. Washington, D.C., May.

U.S. EPA, October 2004. "Region 9 Preliminary Remediation Goals (PRGs)", EPA Region IX, 75 Hawthorne Street, San Francisco, California, 94105.

APPENDIX A

HEALTH AND SAFETY PLAN

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-04-D-0055

Health and Safety Plan
for
SITE 22– OLD DRY CLEANING FACILITY
ERH TREATABILITY STUDY

Naval Station Great Lakes
Great Lakes, Illinois

Contract Task Order 0009

March 2006

NAVFAC
Naval Facilities Engineering Command
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

TETRA TECH NUS, Inc.

HEALTH AND SAFETY PLAN
FOR
SITE 22– OLD DRY CLEANING FACILITY
ERH TREATABILITY STUDY
AT THE
NAVAL STATION GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION-NAVY (CLEAN) CONTRACT

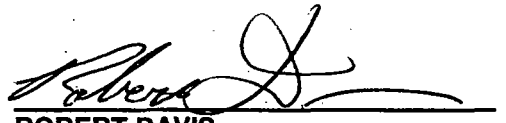
Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
TETRA TECH NUS
661 Andersen Drive Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 0009

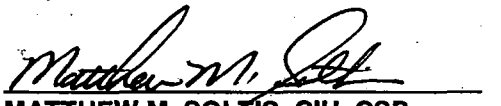
MARCH 2006

PREPARED UNDER THE SUPERVISION OF:



ROBERT DAVIS
TASK ORDER MANAGER
TETRA TECH NUS
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:



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1.0 INTRODUCTION

Authorization: This Health and Safety Plan (HASP) and the work described within are completed under the authorization of:

Contract: Comprehensive Long-Term Environmental Action Navy (CLEAN IV)
Contract Number: N62467-04-D-0055
Contract Task Order: 0009

Application: This Health and Safety Plan (HASP) has been written to encompass site activities that are to be conducted at the Naval Station Great Lakes, Illinois. Activities to be conducted as per this HASP are defined in detail in Section 4.0.

Compliance: The elements of this HASP are intended to be in compliance with the requirements established by:

- OSHA 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER)
- Applicable sections of 29 CFR 1926 "Safety and Health Regulations For Construction."
- Tetra Tech NUS Health and Safety Program

This HASP must be accompanied by the Tetra Tech NUS, Inc. Health and Safety Guidance Manual (TtNUS HSGM). The Guidance Manual provides additional information on program support, standard operating procedures, and safe work practices.

Modifications/Changes: The following conditions are considered sufficient basis review and possible changes to this document

- The addition or modification of activities outside of those specified in Section 4.0, Scope of Work.
- New information becomes available through the course of the investigation or from outside sources.

Changes to this HASP will be requested through the Task Order Manager (TOM) to the Tetra Tech NUS Health and Safety Manager (HSM). It is the responsibility of the TOM to notify affected personnel of changes to this HASP. Changes to the HASP will be documented using a Document Review Record.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for TtNUS and subcontractor employees engaged in on-site activities. Personnel assigned to these positions will exercise the primary responsibility for on-site health and safety. These persons will be the primary points of contact for any questions regarding the safety and health procedures and the selected control measures that are to be implemented for on-site activities.

- The TtNUS TOM is responsible for the overall direction of health and safety for this project.

- The Project Health and Safety Officer (PHSO) is responsible for developing this HASP in accordance with applicable OSHA regulations. Specific responsibilities include:
  i. Providing information regarding site contaminants and physical hazards associated with the site and tasks to be conducted.
  ii. Establishing air monitoring and decontamination procedures.
  iii. Assigning personal protective equipment based on task and potential hazards.
  iv. Determining emergency action/response procedures and emergency contacts.
  v. Stipulating training and medical surveillance requirements.
  vi. Providing standard work practices to minimize potential injuries and exposures associated with hazardous waste work.
  vii. Modifying this HASP, as it becomes necessary.

- The TtNUS Field Operations Leader (FOL) is responsible for implementation of the HASP with the assistance of an appointed Site Safety Officer (SSO). The FOL manages field activities, executes the work plan, and enforces safety procedures as applicable to the work plan.

- The SSO supports site activities by advising the FOL on the aspects of health and safety on-site. In this capacity the SSO:
  i. Coordinates health and safety activities with the FOL.
  ii. Selects, applies, inspects, and maintains personal protective equipment.
  iii. Establishes work zones and control points in areas of operation.
  iv. Implements air monitoring program for on-site activities.
  v. Verifies training and medical clearance of on-site personnel status in relation to site activities.
  vi. Implements Hazard Communication, Respiratory Protection Programs, and other associated health and safety programs as they may apply to site activities.
  vii. Coordinates TtNUS emergency actions with the facilities emergency services.
  viii. Provides site-specific training for on-site personnel.
  ix. Investigates accidents and injuries (see Attachment I - Illness/Injury Procedure and Report Form)

x. Provides input to the PHSO regarding the need to modify, this HASP, or applicable health and safety associated documents as per site-specific requirements.

- Compliance with the requirements stipulated in this HASP is monitored by the SSO and coordinated through the TtNUS CLEAN HSM.

Note: In some cases one person may be designated responsibilities for more than one position. For example, the FOL may also be responsible for the SSO duties. This action will be performed only as credentials, experience, and availability permits.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: Naval Station Great Lakes **Address:** NAVFAC Midwest
Building 1A, Code N457
201 Decatur Avenue
Great Lakes, IL 60088

Naval Station Great Lakes Point-of-Contact

Name	Phone Number	Cell Phone	e-mail
Howard Hickey	(847) 688-5999 ext. 148	(847) 815-6719	Howard.Hickey@navy.mil
Blayne Kirsh	(847) 688-5999 ext. 145	(847) 774-8585	John.Kirsh@navy.mil
Mark Schultz	(847) 688-5999 ext. 140	(847) 744-8579	Mark.R.Schultz@navy.mil

Fax Number: (847) 688-2319

U.S. Navy Remedial Project Manager/Engineer-In-Charge: Anthony Robinson (Code ES 31)

Address: 2155 Eagle Drive
North Charleston, South Carolina 29406

Phone Number: (843) 820-7339
Fax Number: (843) 820-7465
E-mail Address: anthony.b.robinson@navy.mil

Base Pass and Security: Building 130 (near Main Gate); Hours of Operation 0600 – 1800
Phone Number: (847) 688-5648
Note: See Section 9.5.1 for Base Access Information.

Purpose of Site Visit: This activity is divided into a multi-task operation (see Section 4.0) including direct-push technology (DPT) soil borings, groundwater sampling and treatability study (in-situ thermal) system installation, operation, and demobilization.

Proposed Dates of Work: March to September 2006

Project Team:

Tetra Tech NUS Personnel:	Discipline/Tasks Assigned:	Phone No.
Robert Davis, P.E.	Task Order Manager	(412) 921-7251 davisb@ttnus.com
Chris Pike, P.E.	Assistant Task Order Manager	(412) 921-8861 chris.pike@ttnus.com
Matthew M. Soltis, CIH, CSP	CLEAN Health and Safety Manager	(412) 921-8912 soltism@ttnus.com
Clyde J. Snyder	Project Health and Safety Officer	(412) 921-8904 snyderc@ttnus.com
To Be Determined	Project Geologist/Field Operations Leader (FOL)	(412) 921-7090

Hazard Assessments (for purposes of 29 CFR 1910.132) and HASP preparation conducted by:
Clyde J. Snyder

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an emergency. In the event of an emergency that cannot be handled by onsite personnel, site personnel will be evacuated to a safe place of refuge and the appropriate emergency response agencies will be notified. It has been determined that the majority of potential emergency situations would be better supported by outside emergency responders. Therefore, TtNUS will only provide emergency response support for minor emergency events within the capabilities of onsite response. Workers who are ill or who have suffered a non-serious injury may be transported by site personnel to nearby medical facilities, provided such transport does not aggravate or further endanger the welfare of the injured/ill person. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of operations, a factor which ensures adequate emergency response time. This emergency action plan conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), as allowed in OSHA 29 CFR 1910.120(l)(1)(ii).

In the event of an emergency, TtNUS personnel will, provide necessary initial response measures for incidents such as:

- Incipient fire-fighting support and prevention
- Incipient spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Provision of initial medical support for injury/illness requiring only first-aid level support
- Provision of site control and security measures as necessary

2.2 EMERGENCY PLANNING

Injuries/illnesses resulting from exposure to chemical or physical contact with hazards and fire are the most probable emergencies that could occur during site activities. To minimize or eliminate these potential emergency situations, emergency planning activities will include the following:

- Coordinating response actions with Naval Station Great Lakes Emergency Services personnel to ensure that TtNUS emergency action activities are compatible with existing facility emergency response procedures.

- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:
  - Chemical Inventory (for substances used onsite), with Material Safety Data Sheets.
  - Onsite personnel medical records (Medical Data Sheets).
  - A logbook identifying personnel onsite each day.
  - Emergency notification phone numbers in site vehicles
- Identifying a chain or command for emergency action.
- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible.

It is the responsibility of the TtNUS FOL to ensure that this information is available and present at the site.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

It is anticipated that foreseeable emergency situations that may be encountered during site activities will be recognizable by worker observation or through air monitoring equipment readings. Through site-specific training, site personnel will have knowledge regarding the signs and symptoms of overexposure to contaminants of concern. This knowledge will assist site personnel in identifying potential emergency situations and to alert personnel of potential hazards. Many of the potential hazards and recommended control measures are discussed in Sections 5.0 and 6.0 of this document. Additionally, early recognition will be supported by periodic site surveys to eliminate conditions that may predispose site personnel or property to an emergency. Site surveys will be conducted at least once a week during the initiation of this effort.

The above actions will provide early recognition for potential emergency situations. Should an incident take place, TtNUS will take defensive and offensive measures to control the situation. However, if the FOL and/or the SSO determine that an incident has progressed to a serious situation, TtNUS will withdraw, and notify appropriate response agencies.

2.3.2 Prevention

TtNUS will minimize the potential for emergencies by following the Health and Safety Guidance Manual and ensuring compliance with the HASP and applicable OSHA regulations. In the event that an activity or operation is covered by more than one of these documents, the most stringent requirement shall apply.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

In the event that the site must be evacuated, personnel will immediately stop activities and report to the TtNUS FOL at the safe refuge area. Safe places of refuge will be determined prior to commencement of site activities and will be conveyed to personnel as part of the daily safety meeting conducted each morning. Upon reporting to the refuge location, personnel will remain there until directed otherwise by the FOL or the on-site Incident Commander of the Emergency Response Team. The FOL or the SSO will take a head count at this location to confirm the location of site personnel. The site logbook will be used to take and record the head count. Ideally, the places of refuge should offer a point for communication.

2.5 EVACUATION ROUTES AND PROCEDURES

An evacuation will be initiated whenever recommended hazard controls are insufficient to protect the health, safety, or welfare of site workers. Once an evacuation is initiated, personnel will proceed immediately to the designated place of refuge, unless doing so would further jeopardize the welfare of workers. In such event, personnel will proceed to a designated alternate location (to be identified) and remain there until further notification from the FOL. The use of these locations as assembly points provides communication and a direction point for emergency services.

Evacuation procedures will be discussed prior to the initiation of work at the site. This shall include identifying primary and secondary evacuation routes and assembly points. Evacuation routes from the site are dependent upon the location at which work is being performed and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) will influence the designation of evacuation routes. As a result, multiple assembly points will be selected at Naval Station Great Lakes, and in the event of an emergency, field personnel will proceed to these points by the most direct route possible without further endangering themselves.

2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

TtNUS personnel will be working in close proximity to each other at Naval Station Great Lakes. As a result, hand signals, voice commands, and line of site communication will be sufficient to alert site personnel of an emergency. When project tasks are performed simultaneously on different sites, vehicle horns will be used to communicate emergency situations.

If an emergency warranting evacuation occurs, the following procedures are to be initiated:

- Initiate the evacuation via hand signals, voice commands, line of site communication, or vehicle horns. The following signals shall be utilized when communication via vehicle horn is necessary:

HELP	three short blasts	▪ ▪ ▪
EVACUATION	three long blasts	▬ ▬ ▬

- Report to the designated refuge point.

- Once non-essential personnel are evacuated, appropriate response procedures will be enacted to control the situation.

- Describe to the FOL (FOL will serve as the Incident Coordinator) pertinent incident details.

In the event that site personnel cannot mitigate the hazardous situation, the FOL and SSO will enact emergency notification procedures to secure additional assistance in the following manner:

Dial 911 and call other pertinent emergency contacts listed in Table 2-1 and report the incident. Give the emergency operator the location of the emergency, the type of emergency, the number of injured, and a brief description of the incident. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

2.7 EMERGENCY CONTACTS

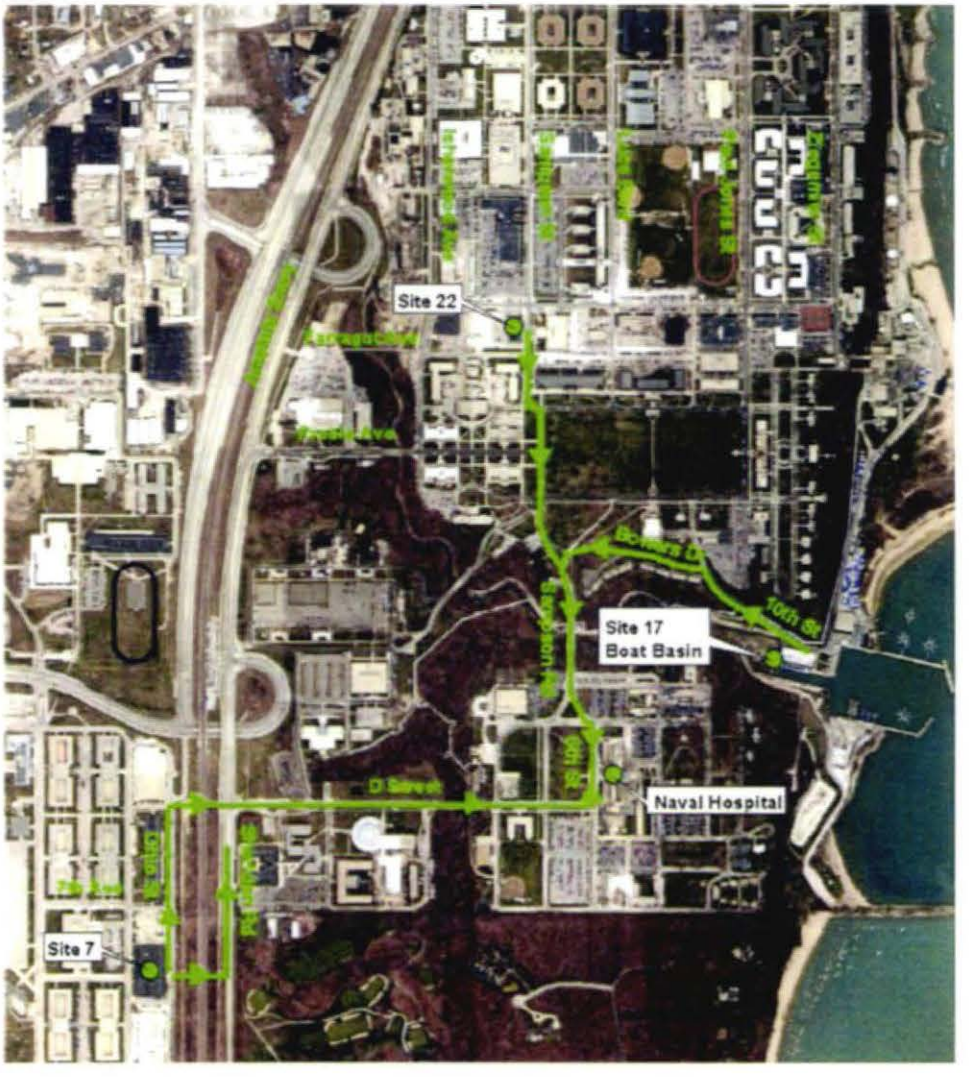
Prior to performing work at the site, personnel will be briefed on the emergency procedures to be followed in the event of an incident. A mobile phone shall be available on site. Table 2-1 provides a list of emergency contacts and their corresponding telephone numbers. This table must be posted on site where it is readily available to site personnel.

TABLE 2-1
EMERGENCY REFERENCE
NAVAL STATION GREAT LAKES

AGENCY	TELEPHONE
EMERGENCY Police Fire/Hazardous Materials Release Ambulance Services	**9-1-1** (847) 688-3333
Base Contact, Mr. Howard Hickey	(847) 688-5999 x 148 (847) 815-6719
Great Lakes Naval Hospital (till May 31, 2006)	(847) 688-3300 Duty Officer (847) 688-3333 Ambulance (847) 688-6855 Emergency
North Chicago VA Medical Center (after June 1, 2006)	(847) 473-7830
Poison Control Center	(800) 222-1222
Task Order Manager Robert Davis	(412) 921-7251
CLEAN Health and Safety Manager Matthew Soltis, CIH, CSP	(412) 921-8912
Project Health and Safety Officer Clyde J. Snyder	(412) 921-8904
Utility Location (5 Working Days Advance Notification Required) Ms. Judy Jarosz (Primary) Mr. Chuck Kelly (Back-up) IL JULIE Program	 (847) 688-2121 Ext. 18 (847) 688-2121 Ext. 10 (800) 892-0123
Utility Emergency – Public Works Dept. – Naval Station Great Lakes (Monday – Friday 0700 – 1630) Trouble Desk (Holidays and Saturday/Sundays)	(847) 688-3849 (847) 688-4820
Chemtrec	(800) 424-9300
National Response Center	(800) 424-8802
Tetra Tech NUS, Pittsburgh Office	(412) 921-7090

2.8 EMERGENCY ROUTE TO HOSPITAL

Great Lakes Naval Hospital (through May 31, 2006)



For emergency care only, non-Navy personnel are permitted to go to the Navy Hospital through May 31, 2006:

Great Lakes Naval Hospital
3001A Sixth Street
Great Lakes, Illinois 60088-2833
(Sheridan Road and South Gate Entrance)

From Site 22 - Building 105 – Former Dry Cleaning Facility

1. Exit Site 22 Turn Right onto Sampson Street (South).
2. The hospital is on the left
3. Follow signs to the appropriate entrance to the hospital (3001A Sixth Street).

2.8 EMERGENCY ROUTE TO HOSPITAL

North Chicago Va Medical Center (starting June 1, 2006)

Great Lakes Naval Training Center, Il to Veterans Affairs Medical Center (NORTH CHICAGO), Il.
Distance: 1.7 miles (2.7km)Traveled on This Map: 1.7 miles (2.7km)

1. Start out heading WEST on BUCKLEY ROAD towards IL-137. Drive for 0.1 miles.
2. Turn LEFT to get on N SKOKIE HIGHWAY heading SOUTH. Drive for 0.1 miles.
3. Make a U-turn at BEACON STREET. Drive for 0.1 miles.
4. Turn RIGHT onto IL-137. Drive for 1 mile.
5. Turn RIGHT onto FORRESTAL VILLAGE QTRS STREET. Drive for a short distance.
6. Turn RIGHT onto FORRESTAL VILLAGE NAVAL HOUSING. Drive for 0.1 miles.
7. Keep LEFT to stay on FORRESTAL VILLAGE NAVAL HOUSING. Drive for a short distance.
8. Keep RIGHT to stay on FORRESTAL VILLAGE NAVAL HOUSING. Drive for 0.1 miles.
9. You have reached the destination.

2.9 DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT

During a site evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. Decontamination will be postponed if the action that initiates an evacuation would further endanger the lives of workers. However, a situation that would require workers to evacuate without first performing decontamination procedures is unlikely to occur at this site. If the emergency involves personnel to exposures to chemicals, follow the steps provided in Figure 2-2.

2.10 INJURY/ILLNESS REPORTING

If TtNUS personnel are injured or develop an illness as a result of working on site, the TtNUS "Injury/Illness Procedure" (Attachment I) must be followed. Following this procedure is necessary for documenting the information obtained at the time of the incident. Also, as soon as possible the Navy Contact must be informed of incidents or accidents that require medical attention.

Pertinent information regarding allergies to medications or other special conditions will be provided to medical services personnel. This information is listed on Medical Data Sheets (Attachment II) filed onsite. If an exposure to hazardous materials has occurred, provide information on the chemical, physical, and toxicological properties of the subject chemical(s) to medical service personnel.

2.11 PPE AND EMERGENCY EQUIPMENT

A first-aid kit, eye wash units (or bottles of disposable eyewash solution) and fire extinguishers (strategically placed) will be maintained onsite and shall be immediately available for use in the event of an emergency. This equipment will be located in each site vehicle. At least one first aid kit supplied with equipment to protect against blood borne pathogens will also be available on site. Personnel identified within the field crew with blood borne pathogen and first-aid training will be the only personnel permitted to offer first-aid assistance.

FIGURE 2-2
POTENTIAL EXPOSURE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of injury situations.
In the event of a personnel injury or accident:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the injured person is a Tetra Tech NUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing which may be appropriate. WorkCare physicians will monitor the care of the victim. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call WorkCare at 1-800-455-6155 and enter Extension 109, or follow the voice prompt for after hours and weekend notification and be prepared to provide:
  - Any known information about the nature of the injury.
  - As much of the exposure history as was feasible to determine in the time allowed.
  - Name and phone number of the medical facility to which the victim(s) has/have been taken.
  - Name(s) of the involved Tetra Tech NUS, Inc. employee(s).
  - Name and phone number of an informed site officer who will be responsible for further investigations.
  - Fax appropriate information to WorkCare at (714) 456-2154.
- Contact Corporate Health and Safety Department (Matt Soltis) and Human Resources Manager Marilyn Duffy at 1-800-245-2730.
- As data is gathered and the scenario becomes more clearly defined, this information should be forwarded to WorkCare.

WorkCare will compile the results of the data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. A personalized letter describing the individual findings/results will accompany this generalized summary. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

FIGURE 2-2 (continued)
WORKCARE
POTENTIAL EXPOSURE REPORT

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

Client Contact: _____ Phone No.: _____

Company Name: _____

I. Exposing Agent

Name of Product or Chemicals (if known):_____

_____

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing?_____

How long did individual work in area before signs/symptoms developed? _____

Was protective gear being used? If yes, what was the PPE? _____

Was their skin contact? _____

Was the exposing agent inhaled?_____

Were other persons exposed? If yes, did they experience symptoms? _____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Nausea / Vomiting
Dizziness
Weakness

Delayed Symptoms:

Weakness
Nausea / Vomiting
Shortness of Breath
Cough
Loss of Appetite
Abdominal Pain
Headache
Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Cyanosis
Nausea / Vomiting
Dizziness
Weakness
Loss of Appetite
Abdominal Pain
Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)
Improved: _____ Worsened: _____ Remained Unchanged: _____

V. Treatment of Symptoms (check off appropriate response)

None: _____ Self-Medicated: _____ Physician Treated: _____

3.0 SITE BACKGROUND

3.1 SITE DESCRIPTION

The Naval Station Great Lakes is located in Lake County, Illinois, on the shore of Lake Michigan about 50 miles north of downtown Chicago. Dedicated in 1911, Naval Station Great Lakes is the largest naval training center in the United States. Naval Station Great Lakes consists of approximately 1,650 acres with over 1,000 buildings.

3.2 SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY

Building 105 is located at the Naval Station Great Lakes in Lake County, Illinois.

Building 105 was constructed in 1939 and was utilized as a dry cleaning facility until 1993 or 1994 when it was converted to a vending machine supply and repair station until February 2001. The dry cleaning facility consisted of a slab-on-grade building that included a RCRA storage unit. The 10,500-square foot building (150 feet by 70 feet) occupied a lot approximately 250 feet by 115 feet. The building was demolished in March 2003.

Soil and groundwater sampling has taken place at Building 105 (groundwater), the "hot spot" is located on the southern and eastern sides of the former building along Sampson Street.

4.0 SCOPE OF WORK

This section discusses the specific tasks that are to be conducted as part of this scope of work as identified in the workplan for CTO 0009. These tasks are the only ones addressed by this HASP. Any tasks to be conducted outside of the elements listed here will be considered a change in scope requiring modification of this document. The TOM or a designated representative will submit the requested modifications to this document to the HSM.

Specific tasks to be conducted include, but are not necessarily limited to, the following:

- Mobilization/demobilization
- Subcontractor oversight of in-situ thermal Treatability study system [Electrical Resistive Heating (ERH)] installation, operation, and demobilization.
- Monitoring Well Installation/Construction/Abandonment, using direct push technology (DPT) and hollow stem auger.
- Multi-media Sampling including:
  - Surface soil sampling
  - Subsurface soil sampling (during ERH Treatability Study)
  - Ground water sampling
  - Investigative and Remediation Derived Waste sampling
- Decontamination
- Ground water level measurements
- Investigation and Remediation-derived waste handling and disposal
- Site Restoration
- Land Surveying

For more detailed description of the associated tasks, refer to the Work Plan (WP).

4.1 ELECTRICAL RESISTANCE HEATING (ERH) TREATABILITY STUDY

The installation of the infrastructure for an ERH treatability study at Site 22 will be performed by Thermal Remediation Services (ERH subcontractor) and TTL Associates (drilling subcontractor) under the supervision of Jerry Wolf and Rick Mielcarek respectively. The treatability study will consist of utilizing ERH to treat an area of approximately 2,400 square feet located in the vicinity of the maximum contamination observed on site. The area will be treated to a depth ranging from 8 to 25 feet. Thermal

Remediation Services will prepare a Health and Safety Plan for this phase of the operation and is attached to this HASP as Attachment VII. TtNUS will review the HASP prior to site mobilization. TtNUS personnel will provide oversight for the ERH Treatability Study (system installation, operation, and demobilization).

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES

Table 5-1 of this section serves as the primary portion of the site specific HASP for TtNUS and TTL Associates and supplements Thermal Remediation Services HASP in Attachment VII. This table is intended to assist project personnel in the recognition of hazards and recommended procedures necessary to minimize potential exposure or injuries related to those hazards. The table also assists field team members in determining which personal protective equipment (PPE) and decontamination procedures to be used as well as appropriate air monitoring techniques and site-specific conditions. The evaluation of each task provides detailed information including anticipated hazards, recommended control measures, air monitoring recommendations, required PPE, and decontamination measures. This table must be updated if the scope of work, contaminants of concern or pertinent conditions change.

Table 5-1 and the HASP are not meant to be stand alone documents and must be accompanied by the TtNUS Health and Safety Guidance Manual. This manual is designed to further explain supporting elements for any site specific operations as required by 29 CFR 1910.120. The Guidance Manual should be referenced for additional information regarding air monitoring instrumentation, decontamination activities, emergency response, hazard assessments, hazard communication and hearing conservation programs, medical surveillance, PPE, respiratory protection, site control measures, standard work practices, and training requirements. Many of TtNUS's SOPs are also provided in the Guidance Manual.

Safe Work Permits will be issued for the exclusion zone activities (See Section 10.2). The FOL and/or the SSO will use the elements defined in Table 5-1 as the primary reference. The FOL and/or the SSO completing the Safe Work Permit will add additional site-specific information as warranted. In situations where the Safe Work Permit is more conservative than the direction provided in Table 5-1 due to the incorporation of site-specific elements, the Safe Work Permit will be followed.

5.1 GENERAL SAFE WORK PRACTICES

In addition to the task-specific work practices identified on Table 5-1, the following general safe work practices are to be followed when conducting work on-site. These safe work practices address a pattern of general precautions and measures for reducing risks associated with site operations. This list may be amended as necessary.

- Eating, drinking, chewing gum or tobacco, taking medication, or smoking is prohibited in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists.

- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible if excessive skin contamination occurs.

- Avoid contact with potentially contaminated substances. Avoid puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on equipment. Keep monitoring equipment away from potentially contaminated surfaces.

- Take note of the location of the nearest telephone and emergency telephone numbers. See Section 2.0, Table 2-1.

- Attend briefings on anticipated hazards, equipment requirements, safe work permits, emergency procedures, and communication methods before going on site.

- Plan and mark entrance, exit, and emergency escape routes. See Section 2.0.

- Rehearse unfamiliar operations prior to implementation.

- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity to assist each other in case of emergency.

- Establish appropriate Safety Zones including Support, Contamination Reduction, and Exclusion Zones.

- Minimize the number of personnel and equipment in contaminated areas (such as the Exclusion Zone). Non-essential vehicles and equipment should remain within the Support Zone.

- Establish appropriate decontamination procedures for leaving the site.

- Immediately report injuries, illnesses, and unsafe conditions, practices, and equipment to the Site Safety Officer (SSO).

- Matches and lighters are restricted from entering in the Exclusion Zone or Contamination Reduction Zone.

- Observe coworkers for signs of toxic exposure and heat or cold stress.

- Inform co-workers of potential symptoms of illness, such as headaches, dizziness, nausea, or blurred vision.

5.2 SOIL BORING - SAFE WORK PRACTICES

The following Safe Work Practices are to be followed when working in or around drilling operations.

- Identify underground utilities and buried structures before drilling. Use the Utility Locating and Excavation Clearance SOPs provided in Appendix III.

- Drilling rigs (DPT and HSA) will be inspected by a competent person (the SSO or designee) prior to the acceptance of the equipment at the site and prior to the use of the equipment. Repairs or deficiencies identified will be corrected prior to use. The inspection will be accomplished using the Equipment Inspection Checklist provided in Appendix IV. Inspection frequencies will be once every 10 day shift or following repairs.

- The work area around the point of operation will be graded to the extent possible to remove any trip hazards near or surrounding operating equipment.

- The driller's helper will establish an equipment staging and lay-down plan. The purpose of this is to keep the work area clear of clutter and slips, trips, and fall hazards. Mechanisms to secure heavy objects, such as drill flights, will be provided to avoid the collapse of stacked equipment.

- Potentially contaminated tooling will be wrapped in polyethylene sheeting for storage and transport to the centrally located decontamination unit.

- Prior to drilling, one member of the crew will be identified as the person with primary responsibility for engaging the emergency shut-off device in the event of an emergency. This person will be responsible for visually verifying that the area is clear and for verbally alerting site personnel prior to engaging the equipment.

- Minimize contact to the extent possible with contaminated tooling and environmental media.

- Support functions (sampling and screening stations) will be maintained a minimum distance from the drilling rig of the height of the mast plus 5 ft. to remove these activities from within physical hazard boundaries.

- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the drill rig.

- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should move heavy tooling, where necessary.

- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone. Site visitors will be escorted.

- Equipment used within the exclusion zone will undergo a complete decontamination and evaluation by the SSO to determined cleanliness prior to moving to the next location, exiting the site, or down time for maintenance.

- Motorized equipment will be fueled prior to the commencement of the day's activities. During fueling operations equipment will be shutdown and bonded to the fuel provider.

- When not in use, drill rigs will be shutdown, emergency brakes set, and wheels chocked. Areas subjected to subsurface investigative methods will be restored to equal or better condition than original to remove any contamination brought to the surface and to remove any physical hazards. In situations where these hazards cannot be removed, these areas will be barricaded to minimize the impact on field crews working in the area.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES NTC GREAT LAKES, GREAT LAKES, ILLINOIS

Task/Operation/Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Multi-media sampling, including - Surface water – direct pour or pump - Ground water – Peristaltic - Surface soils and – Trowel - Subsurface soils – DPT/HSA with split spoon during ERH Treatment, - Hand auger, soil corers, and mechanized support (See Soil boring Table 5-1). - IDW – Trowel, soil corer, or pump.	***Chemical hazards:*** 1) Previous analytical data available for the work areas identified the following contaminants: • 1,1 Dichloroethane • 1,2 Dichloroethene • Tetrachloroethylene • Trichloroethene Elevated airborne readings are unlikely to be encountered during site activities. Further information on these contaminants are provided in Table 6.1. 2) Transfer of contamination into clean areas. ***Physical hazards:*** 3) Slip, trip, and fall hazards 4) Strain/muscle pulls from manual lifting 5) Cuts and Lacerations 6) ERH Sampling 7) Ambient temperature extremes (heat/cold stress) 8) Site Characterization ***Natural hazards:*** 9) Animal and insect bites and encounters 10) Inclement weather	***Chemical hazards:*** 1) Safe work practices will be employed as the first line of defense. As a general rule, avoiding contact with contaminated media (air, water, soils, etc.) will be employed as a universal control measure. Soils with a Elevated Temperature due to the treatment procedure will be of concern to site workers, minimize potential exposure with sampling materials by using heavy duty cotton gloves along with good work and personal hygiene practices. These control measures including avoiding hand-to-mouth contact to the extent possible, washing hands and face or using hygienic wipes to remove potential contaminants from hands and face prior to breaks or lunch or other hand to mouth activities will restrict the most predominant route of exposure. Dust suppression methods including area wetting will be employed to control mechanically generated dust emissions. *Liquids/gases* – In situations where contaminants exist in soils or liquid media and present a vapor or gas hazard threat, real time monitoring instruments and PPE will be employed to support protective measures. As part of the evaluation method of these subsurface media, all samples will be scanned with a PID to determined potential source concentration. 2) Transfer of Contamination into Clean Areas - Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. See decontamination of heavy and sampling equipment for direction in this task. 3) Slip, Trip, and Fall Hazards – These hazards shall be minimized by adherence to the practices listed below. This includes - Maintain proper housekeeping in all work areas. - Preview and inspect work areas to identify and eliminate slip, trip, or fall hazards. - Cover, guard, barricade, and or place warning postings over/at holes or openings that personnel may fall or step into. - For traversing steep, slippery, or sloped terrain establish rope ladders to control ascent and descent to sampling areas or use alternative pathways. - Regular Ladders should be placed to allow access and egress from steep embankment and levy walls when collecting samples along Pettibone Creek and the Boat Basin. - Use multiple persons and pack small loads to remote locations. 4) Strain/Muscle Pulls from Manual Lifting - Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques (See Lifting Mobilization/Demobilization, Page 1 of 6, Table 5-1). 5) Cuts and Lacerations – Employ the following measures to reduce and/or eliminate the potential for cuts and lacerations - Select and secure the most favorable route to monitoring wells and sampling locations. - Previewing pathways - Where possible, remove or demarcate the physical hazards. - Inspect all cutting equipment to be used to clear access routes for defects. - When cutting items - always use a sharp knife and always cut away from your body. Do not place items to be cut in your opposite hand or on your knee. - Carry all glassware and items that present a potential for cuts, lacerations, or impalement such as machetes or brush hooks in protective packaging or sheathed to avoid breakage or exposure in the event of a slip, trip, and/or fall. 6) The temperature of the sampling liners could be in excess of 140 degrees F and could be a burn hazard. Sampling will be accomplished using split spoons, stainless steel or brass liners when handling the samplers site personnel will wear heavy duty cotton gloves. (See health and Safey Plan Addendum Attachment VI) 7) Ambient Temperature Extremes (Heat/Cold Stress) - Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat/cold stress is provided in Section 4.0 of the Health and Safety Guidance Manual. 8) Site Characterization - Work areas will be surveyed prior to committing personnel or resources. The survey will be conducted by the FOL and/or the SSO. The purpose is to identify physical and natural hazards that may impact the proposed work area. These hazards are to be identified, barricaded, or eliminated to the extent possible to minimize potential effect to field crew. 9) Animal and Insect Bites and Encounters - To combat the potential impact of natural hazards, the following actions are recommended: - Avoid nesting – Preview routes, avoid nests, if at all possible. - Wear light color clothes. This will allow easier detection of ticks and insects crawling on your body. It will also assist in heat stress control. - Tape pant legs to work boots to block direct access. - Use repellents – Permanone should be applied liberally to the clothing, but not the skin as it may cause irritation. Concentrate on areas where ticks and other insects may access your body such as pant cuffs, shirt to pants, and collars. - Upon exiting the high brush and wooded areas perform a close body inspection to remove any ticks or other insects that have attached to your clothing or skin. - If working in snake infested areas personnel are directed to adhere to the following provisions: a. Leave snakes and animals alone, do not harass or try to capture. Contact the SSO for direction in the removal of animals and snakes within the confines of the work site. b. Snake chaps or high leather boots should be worn in unimproved or unmaintained areas on an initial sweep of the area, if you are unknowledgeable regarding nesting and habitat considerations for indigenous animals and reptiles. c. Keep hands and feet out of areas you cannot see. Exercise extreme care when lifting materials or debris providing ground cover as snakes and other animals prefer these areas to nest. d. Be cautious when moving debris or other structures, that may serve as a nest. Do not use your hands to separate debris piles. Use equipment (hand tools or heavy equipment, as available). - As this activity may take personnel into areas of heavier vegetation, samplers should be cognizant of poison ivy, poison oak, and poison sumac in the area. See Section 6.3.3 for descriptions of these plants. Protective measures to be used to minimize hazards of this nature a. Avoid direct contact through the use of Tyvek coveralls, clothing, or barrier creams b. Wash after contact with cool water and mild soap. c. Wash equipment contaminated with the oils of these plants to avoid cross contamination. 10) Suspend or terminate operations during electrical storms. Return to work when directed by the FOL and/or the SSO.	1) Monitoring shall be conducted to as a general screening effort to qualify and quantify estimated source concentrations of site contaminants in support of the prescribed worker protection levels. Monitoring shall be conducted using a Photoionization Detector (PID) with 11.7eV lamp strength. Action level – Any sustained reading greater than 10 ppm in the workers breathing zone for no greater than 10 minutes duration, no more than 4 occurrences in a single day. Action levels of this level will protect personnel from achieving the most conservative TLV/TWA. Concentration in excess of this action level require personnel to stop work, notify PHSO.	Level D protection will be utilized for the following sampling activities Surface water, groundwater and soils Sampler/Oversight Personnel - Standard field dress (long pants, Sleeved shirts) - Steel toe safety shoes or work boots - Safety Glasses - Nitrile surgeon style inner gloves for sampling - *Impermeable boot covers* - *Reflective vest for traffic areas* - *Identified flotation devices* Protective Measures as specified for drilling and soil boring will be employed for all subsurface soil sampling. Upgrades to Level C protection are not anticipated. **Note:** The Safe Work Permit(s) for this task (See Attachment VI) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** Sampling surface water, groundwater, and soils, the following provisions will apply Upon completion of the sampling dedicated trowels, tubing, etc. will be bagged for transport back to the central decontamination area. - PPE (gloves) will be removed and also bagged for disposal. - Handi-Wipes or similar product will be used to clean hands, prior to moving to the next location. **Equipment Decontamination** All equipment used in remote sampling locations will be brought back to the central decontamination area for decontamination and re-use or disposal.

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Decontamination of Sampling and Heavy Equipment It is anticipated that this activity will take place at a centralized location. Gross contamination will be removed to the extent possible at the site. Contaminated tooling then will be wrapped in polyethylene sheeting for transport to the centralized location for a full decontamination and evaluation.	***Chemical hazards:*** Soils – Surface/Subsurface soils, groundwater, and surface water – concentrations are anticipated to be negligible. See Section 6.1 for information concerning the general contaminant groups anticipated. 2) Decontamination fluids - Liquinox (detergent); isopropanol (decontamination solvent) ***Physical hazards:*** 3) Lifting (strain/muscle pulls) 4) Noise in excess of 85 dBA 5) Flying projectiles 6) Falling hazards 7) Slips, trips, and falls ***Natural hazards:*** 8) Inclement weather	1) and 2) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Control potential non-occupational exposures through good work hygiene practices (i.e., avoid hand to mouth contact; wash hands and face before breaks and lunch; minimize contact with contaminated media). Obtain manufacturer's MSDS for any decontamination fluids used on-site. Solvents may only be used in well-ventilated areas, such as outdoors. Use appropriate PPE as identified on MSDS or within this HASP. All chemicals used must be listed on the Chemical Inventory for the site, and site activities must be consistent with the Hazard Communication Program provided in Section 5.0 of the TtNUS Health and Safety Guidance Manual. 3) Use multiple persons where necessary for lifting and handling heavy equipment for decontamination purposes. - Employ proper lifting techniques as described in Table 5-1, Mobilization/Demobilization. 4) Wear hearing protection when operating the pressure washer and/or steam cleaner. Sound pressure levels measured during the operation of similar pieces of equipment indicate a range of 87 to 93 dBA. 5) Use eye and face protective equipment when operating the pressure washer and/or steam cleaner, due to flying projectiles. All other personnel must be restricted from the area. In addition to minimize hazards (flying projectiles, water lacerations and burns) associated with this operation, the following controls will be implemented - A Fan Tip 25° or greater will be used on pressurized systems over 3,000 psi. This will reduce the possibility of water lacerations or punctures. - Thermostat control will be in place and operational to control the temperature levels of the water where applicable. - Visual evaluations of hoses and fittings for structural defects - Construct deflection screens as necessary to control overspray and to guard against dispersion of contaminants driven off by the spray. 6) Insure wash and drying racks are of suitable construction to prevent heavier items such as push rod flights from falling during the decontamination process. 7) The decontamination pad should be constructed to contain wash waters generated during decontamination procedures. Temporary decontamination pads are usually 10-30 mil polyethylene or polyvinyl chloride tarp construction. Although these items when used as a liner offer containment, they also present a slipping hazard. When these temporary liners are employed, it is recommended that a light coating of sand be spread over the walking surface to provide traction. - In addition, adequate slope should be provided to the pad to permit drainage away from the object being cleaned. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. - Hoses should be gathered when not in use to eliminate potential tripping hazards. 8) Suspend or terminate operations until directed otherwise by SSO.	Use visual observation and real-time monitoring instrumentation to ensure all equipment has been properly cleaned of contamination and dried. Monitoring instrumentation will be employed to determine if all of the decontamination solvent (isopropanol) has been removed through the rinse process. Any positive indication/results greater than background require the article that has been decontaminated to be re-rinsed and scanned again. If necessary this process should be repeated until no measurable indication of the decontamination solvent exists.	<u>For Heavy Equipment</u> This applies to pressure washing and/or steam cleaning operations and soap/water wash and rinse procedures. Level D Minimum requirements: - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Chemical resistant boot covers - Nitrile outer gloves over nitrile inner gloves - Safety glasses underneath a splash shield - Hearing protection (plugs or muffs) - Hooded PVC Rainsuits or PE or PVC coated Tyvek. Impermeable aprons may be used instead of coveralls if they offer adequate protection against overspray and back splash. **For sampling equipment** (trowels, bailers, etc.), the following PPE is required **Note**: Consult MSDS for PPE guidance for decontamination fluids/solvents. Otherwise, observe the following. Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Nitrile outer gloves over nitrile inner gloves - Safety glasses - Impermeable apron In the event of overspray of chemical decontamination fluids, employ PVC Rainsuits or PE or PVC coated Tyvek as necessary. **Note:** The Safe Work Permit(s) for this task (See Attachment VI) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** will consist of a soap/water wash and rinse for reusable and non-reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable). The sequential procedure is as follows: Stage 1: Equipment drop, remove outer protective wrapping; personnel will wipe down the outer shell and pass hand equipment through as necessary. Stage 2: Soap/water wash and rinse of outer boots and gloves Stage 3: Soap/water wash and rinse of the outer splash suit, as applicable Stage 4: Disposable PPE and equipment will be removed and bagged. Stage 5: Wash face and hands **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing a steam cleaner or pressure washer. Heavy equipment will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will have restricted access to exclusion zones, and have their wheels/tires cleaned/sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the on-site activity. **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements indicated within the Work Plan. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving on-site, leaving the site, and between locations. No equipment will be authorized access, exit, or movement to another location without this evaluation.

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type And Action Levels	Personal Protective Equipment *(Items In Italics Are Deemed Optional As Conditions Or The FOL Or the SSO Dictate.)*	Decontamination Procedures
IDW Management and Handling This activity includes the following tasks: - Containerization - Labelling - Staging - Monitoring of IDW generated in support of site activities.	***Chemical hazards:*** The only anticipated hazard associated with IDW management is the potential for a spill. In situations such as that the spill containment program identified in Section 10.0 of this HASP will be employed. ***Physical hazards:*** 1) Strains and sprains 2) Back injuries 3) Compressions 4) Loading bulk transport containers	***Chemical hazards:*** It is not anticipated that chemical hazards will be significant during this operation, as the IDW will be in sealed containers. However, control measures such as the use of PPE and good work hygiene practices will be used to control potential exposures during the implementation of the Spill Containment Program (See Section 9.0 of this HASP). ***Physical hazards:*** 1 & 2) Strains and sprains (lifting hazards)/Back Injuries – The predominant hazard associated with this activity is the movement of full or partially full 55-gallon drums of soils and/or water. To minimize hazards of this nature the following provisions shall be incorporated as applicable: - Use machinery (preferred method) or multiple personnel for heavy lifts. - Use proper lifting techniques a. Lift with your legs, not your back, bend your knees move as close to the load as possible, and ensure good hand holds are available. b. Minimize the horizontal distance to the center of the lift to your center of gravity. c. Minimize turning and twisting when lifting as the lower back is especially vulnerable at this time. d. Break lifts into steps if the vertical distance (from the start point to the placement of the lift) is excessive. e. Plan your lifts – Place heavy items on shelves between the waist and chest; lighter items on higher shelves. f. Periods of high frequency lifts or extended duration lifts should provide sufficient breaks to guard against fatigue and injury. In determining whether you can lift or move an item several factors must be considered, these are as follows: - Area available to maneuver the lift. - Area of the lift – Work place clutter, slippery surfaces, rough terrain - Overall physical condition **3)** Compressions – Another hazard frequently associated with this task is the compression of hands and fingers when placing the containers on pallets. This typically occurs when rolling and lowering the container in its place. To combat this hazard, the following provision shall be employed: Material handling devices shall be used for moving drums within the satellite storage area. This includes drum dollies with pneumatic tires, drum grapplers, etc. to handle drums of IDW. These pieces of equipment are engineered to allow placement of these containers while removing hands from the point of operation. Reminder: The drums you are attempting to move, lift and/or relocate weigh on the average of - Full 55-gallon container of purge or decontamination waters = 485 lbs. (including the container) - Full 55-gallon container of soils (moist) = 687 lbs. (including the container) Satellite Storage Area – Emphasis has been placed on the physical surroundings and how they can influence the potential hazards associated with material handling aspects of this task. To further reduce material handling hazards, support spill containment and control, and sampling when necessary, the IDW storage area should be structured as follows: - 4-drums to a pallet with retaining ring bolt and label on the outside for easy access/reference. - Maintain a minimum of 4-feet between each row of pallets. This is the minimum distance necessary to wheel drums on a drum dolley - If the site is not secured, the satellite storage area shall be fenced and signs placed indicating the following: a. Primary Point of Contact (Preferably someone at the Base, and make sure they know they been identified as the Primary Point of Contact). b. Phone Number c. Emergency Contact (If different from the Primary) - Provide a Drum/Container Inventory to the Primary Point of Contact and to Emergency Services, if they deem it necessary. The inventory should contain: a. Each drum shall be assigned a unique identification number. This number shall be placed on the label and drum shell using a paint marker (Note: Do not paint the number on the lid as these have a tendency to get exchanged from time to time.) b. Types of waste materials (Subsurface soils, drill cuttings; purge/development waters, etc.) c. Volumes (Full or level associated with the container after completion of the project location) d. Where it was derived from (IDW should be separated by Site and media) e. Dates (For all filled containers and at the completion of work for that area or Site) f. Contact – For more information Note: All drums should be labeled with the same information.	None required, unless spill containment provisions are initiated. Then monitoring will proceed as described in the activity associated with the task when the materials were generated such as soil boring or well installation.	Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - Leather or canvas work gloves - *Safety glasses (When utilizing cables or slings to move the containers)* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* PPE changes may be made with the implementation of the Spill Containment Program. This represents the only anticipated modification to this level of protection.	Not required, unless the implementation of the Spill Containment Program is required due to a spill and/or release. At that point the decontamination procedures for those activities such as soil borings and/or well installation will be followed. The reference reflects the tasks conducted when the materials were generated.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES NTC GREAT LAKES, GREAT LAKES, ILLINOIS

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type And Action Levels	Personal Protective Equipment *(Items In Italics Are Deemed Optional As Conditions Or The FOL Or the SSO Dictate.)*	Decontamination Procedures
Land Surveying – Geographical and Geophysical The locations identified to be surveyed are predominantly located within light industrial improved areas.	***Chemical hazards:*** Significant exposure to site contaminants is anticipated to be unlikely given the nature of this task. ***Physical hazards:*** 1) Slips, trips, and falls 2) Struck by 3) Ambient temperature extremes (heat/cold stress) ***Natural hazards:*** 4) Inclement weather 5) Insect/animal bites or stings, poisonous plants, etc.	***Physical hazards:*** 1) Preview work locations and site lines for uneven and unstable terrain. Clear necessary vegetation, establish temporary means for traversing hazardous terrain (i.e., rope ladders, etc.) 2) If hand tools (brush hooks, machetes, etc.) are necessary to clear and carry lines and bench marks to the area of operation the following precautions are recommended: - Insure handles are of good construction (no cracks, splinters, loose heads/cutting apparatus. - Insure all cutting tools are maintained. Blades shall be sharp without knicks and gouges in the blade. - All hand tools (brush hooks, machetes, etc.) with cutting blades shall be provided with a sheath to protect individuals, when not in use. - All personnel will maintain a 10-foot perimeter around persons clearing brush. **Note:** It is not anticipated that trees >2-inch girth will be required to be dropped as part of this operation or that significant amount of clearing will be required. Therefore the use of chainsaws and chippers as well as other motorized equipment will not be addressed. 3) Ambient Temperature Extremes (Inclement Weather) – To minimize hazards of this nature, the following provisions shall be employed - Wear appropriate clothing for weather conditions. - Provide acceptable shelter and replacement liquids for field crews as relief from excessive ambient temperatures. - Under conditions of elevated temperatures allow for periods of acclimatization. ***Natural hazards:*** 4) Suspend or terminate operations until directed otherwise by SSO 5) To combat the potential impact of natural hazards, the following actions are recommended - Avoid nesting – Preview routes, avoid nests if at all possible. - Wear light color clothes. This will allow easier detection of ticks and insects crawling on your body. It will also assist in heat stress control. - Tape pant legs to work boots to block direct access. - Use repellents – Permanone should be applied liberally to the clothing, but not the skin as it may cause irritation. Concentrate on areas where ticks and other insects may access your body such as pant cuffs, shirt to pants, and collars. - Upon exiting the high brush and wooded areas perform a close body inspection to remove any ticks or other insects that have attached to your clothing or skin. - If clearing lines in snake infested areas, surveyors are recommended to wear snake chaps, as a precaution. - As this activity may take personnel into areas of heavier vegetation, samplers should be cognizant of poison ivy, poison oak, and poison sumac in the area. See Section 6.3 of this HASP for descriptions of these plants. Protective measures to be used to minimize hazards of this nature a) Avoid direct contact through the use of Tyvek coveralls, clothing, or barrier creams b) Wash after contact with cool water and mild soap. c) Wash equipment contaminated with the oils of these plants to avoid cross contamination. See Section 4.0 of the TtNUS Health and Safety Guidance Manual for additional information concerning natural hazards. -	Air monitoring is not required given the unlikelihood that airborne contaminants will be present. The potential for exposure to site contaminants during this activity is considered minimal.	Surveying activities shall be performed in Level D protection Level D Protection consists of the following: - Standard field dress including sleeved shirt and long pants - Shoes rugged lug sole for traction - Work gloves shall be worn when clearing brush. - *Safety glasses, hard hats (if working near machinery, overhead hazards, or clearing brush)* - *Snake chaps for heavily wooded area where encounters are likely.* - *Tyvek coveralls may be worn to provide additional protection against poisonous plants and insects, particularly ticks.* - *Reflective or blaze orange vests should be worn when working along traffic thoroughfares.* - *Identified flotation devices for work on or near waters edge.* **Note:** The Safe Work Permit(s) for this task (See Attachment VI) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** - A structured decontamination is not required as the likelihood of encountering contaminated media is considered remote. However, survey parties should inspect themselves and one another for the presence of ticks when exiting wooded areas, grassy fields, etc. This action will be employed to stop the transfer of these insects into vehicles, homes, and offices. In addition, early detection shall provide for early removal.

6.0 HAZARD ASSESSMENT

This section provides information regarding the chemical, physical, and natural hazards associated with the sites to be investigated and the activities that are to be conducted as part of the scope of work. Table 6-1 provides information on potential chemical contaminants, including exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data.

6.1 CHEMICAL HAZARDS

The potential health hazards associated with Naval Station Great Lakes include inhalation, ingestion, and dermal contact of various contaminants that may be present in shallow and deep soils, and groundwater. The following have been identified as the primary contaminants, including:

- 1,1 Dichloroethane
- 1,2 Dichloroethene
- Tetrachloroethylene
- Trichloroethene

It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (soil borings, sampling, etc.). Exposure to site contaminants is most likely to occur through inhalation or dermal contact of contaminated soil or water, or through ingestion via hand-to-mouth contact during soil disturbance activities. For this reason, PPE and basic hygiene practices (e.g., washing face and hands before leaving site) will be extremely important. Airborne concentrations of detectable site contaminants will be monitored and evaluated using a PID and visual observation. Given the nature of planned activities and that work will be conducted outside in the open air, it us unlikely that any appreciable airborne concentrations will be present. Any elevated readings in worker breathing zones will require site activities to be suspended.

Other sources of potential chemical exposure are decontamination fluids (e.g., Liquinox, isopropanol), and analytical preservatives. For any substances brought onto the site, the SHSO is responsible for instituting a site-specific Hazard Communication Program (see Section 5.0 of the TtNUS Health and Safety Guidance Manual) and for collecting the appropriate Material Safety Data Sheets (MSDS) from the chemical manufacturers/suppliers. The SHSO is also responsible for completing the Safe Work Permit for the decontamination task using the appropriate MSDS and for reviewing the contents of the MSDSs and Safe Work Permit with anyone who will use these substances.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
NAVAL STATION, GREAT LAKES ILLINOIS

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
1,1-Dichloroethane	75-34-3	PID: I.P. 11.06 eV, relative response ratio unknown. FID: 80% relative response ratio with FID.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with OSHA Method #07-B or NIOSH Method #1003	OSHA; NIOSH; ACGIH: 100 ppm IDLH: 4000 ppm	Questionable warning properties - Odor threshold 49 - 1359 ppm. APRs may be employed for escape only. Exceedances over the exposure limits are recommended to use airline or airline/APR combination type respirator. Recommended glove: Butyl; Polyvinyl alcohol; Viton	**Boiling Pt:** 135°F; 57°C **Melting Pt:** -143°F;-97°C **Solubility:** 0.6% **Flash Pt:** 2°F; -17°C **LEL/LFL:** 5.6% **UEL/UFL:** 11.4% **Vapor Density:** 3.42 **Vapor Pressure:** 182 mmHg **Specific Gravity:** 1.18 **Incompatibilities:** Strong oxidizers, strong caustics **Appearance and odor:** Colorless, oily liquid with a chloroform-like odor.	Overexposure may result in CNS depression, skin and eye irritation, and damage to the liver, kidneys, and lungs.
1,2-Dichloroethylene 1,2-Dichloroethene	540-59-0	PID: I.P. 9.65 eV, high response with PID and 10.2 eV lamp. FID: 50% response with FID.	Air sample using charcoal tube; and carbon disulfide desorption; Sampling and analytical protocol in accordance with OSHA Method #07; and NIOSH Method #1003.	OSHA; NIOSH; ACGIH: 200 ppm IDLH: 1000 ppm	Adequate- odor threshold 0.085-17 ppm. Use organic vapor/acid gas cartridges for exceedances above the TWA up to 1,000 ppm. >1,000 ppm should use pressure-demand supplied air respirator above exposure limits. **Recommended glove:** nitrile - 0.12 hrs; viton - 0.95 hrs	**Boiling Pt:** 117°F; 47°C **Melting Pt:** 7°F; -13.8°C **Solubility:** 0.4% **Flash Pt:** 36°F; 2.2°C **LEL/LFL:** 5.6% **UEL/UFL:** 12.8% **Vapor Density:** 2.0 **Vapor Pressure:** 180-260 mmHg **Specific Gravity:** 1.27 @ 90°F; 32°C **Incompatibilities:** Strong oxidizers, alkalis, potassium hydroxide, and copper. When heated to decomposition temperatures will emit toxic fumes of phosgene. **Appearance and Odor:** Colorless liquid with an acrid odor.	Overexposure may result in CNS depression with potential to cause sleepiness, hallucinations, distorted perceptions, and stupor (narcosis). Systemically, symptoms may result in nausea, vomiting, weakness, tremors, and cramps. May also irritate the eyes, skin, and mucous membranes. Chronic exposures may result in dermatitis, liver, kidney, and lung damage.
Tetrachloroethylene See also Perchloroethylene PERK PCE	127-18-4	PID: I.P. 9.32 eV, relative response ratio 200% with 10.6 eV lamp. FID: 70% relative response ratio with a FID.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1003.	ACGIH: 25 ppm 100 ppm STEL OSHA: 100 ppm 200 ppm Ceiling; 300 ppm 5-minute max peak in any 3-hr period. IDLH: 150 ppm	Odor threshold for this substance has been determined to be at airborne concentrations of approximately 47 ppm, which is considered adequate. APR with organic vapor/acid gas cartridges should be used for escape purposes only. Exceedances over the recommended exposure limits requires the use of airline or airline/APR combination units. Recommended glove: Viton, PV alcohol 5-16 hrs; silver shield >6.00 hrs; teflon 10-24 hrs; and Nitrile in that order. The breakthrough time for the nitrile glove ranges between 1.5 - 5.5 hrs. during complete immersion.	**Boiling Pt:** 250°F; 121°C **Melting Pt:** -2°F; 19°C **Solubility:** 0.02% **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** 5.83 **Vapor Pressure:** 14 mmHg @ 77°F; 25°C **Specific Gravity:** 1.62 @ 77°F; 25°C **Incompatibilities:** Strong oxidizers, alkalis, fuming sulfuric acid, and chemically active metals. When heated to decomposition temperatures will emit toxic fumes of chlorine. **Appearance and Odor:** Colorless liquid with a mild chloroform like odor.	Overexposure may result in irritation to eyes, nose, throat, and skin. Potential CNS effects including sleepiness, incoordination, headaches, hallucinations, distorted perceptions, and stupor (narcosis). Systemically, symptoms may result in nausea, vomiting, weakness, tremors, and cramps. Chronic exposures may result in dermatitis, enlarged tender liver, kidney, and lung damage. This material is considered a animal carcinogen (liver tumors), however, inadequate evidence exists concerning carcinogenic potential in humans.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
NAVAL STATION, GREAT LAKES ILLINOIS

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Trichloroethylene	79-01-6	PID: I.P. 9.45 eV, High response with PID and 10.2 eV lamp. FID: 70% Response with FID.	Air sample using charcoal tube; carbon disulfide desorption; Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1022 or #1003.	OSHA: 50 ppm; 200 ppm (Ceiling) ACGIH: 50 ppm; 100 ppm STEL NIOSH: 25 ppm IDLH: 1000 ppm	Inadequate - Odor threshold 82 ppm. APRs with organic vapor/acid gas cartridges may be used for escape purposes. Exceedances over the exposure limits require the use of positive pressure-demand supplied air respirator. Recommended gloves: PV Alcohol unsupported >16.00 hrs; Silver shield >6.00 hrs; Teflon >24.00 hrs; or Viton >24.00 hrs; Nitrile (Useable time limit 0.5 hr, complete submersion for the nitrile selection)	**Boiling Pt:** 188°F; 86.7°C **Melting Pt:** -99°F; -73°C **Solubility:** 0.1% @ 77°F; 25°C **Flash Pt:** 90°F; 32°C **LEL/LFL:** 8% @ 77°F; 25°C **UEL/UFL:** 10.5 @ 77°F; 25°C **Vapor Density:** 4.53 **Vapor Pressure:** 100 mmHg @ 90°F; 32°C **Specific Gravity:** 1.46 **Incompatibilities:** Strong caustics and alkalis, chemically active metals (barium, lithium, sodium, magnesium, titanium, and beryllium) **Appearance and Odor:** Colorless liquid with a chloroform type odor. Combustible liquid, however, burns with difficulty.	Central nervous system effects including euphoria, analgesia, anesthesia, paresthesia, headaches, tremors, vertigo, and somnolence. Damage to the liver, kidneys, heart, lungs, and skin have also been reported. Contact may result in irritation to the eyes, skin, and mucous membranes. Ingestion may result in GI disturbances including nausea, and vomiting NIOSH lists this substance a potential human carcinogen.

6.2 PHYSICAL HAZARDS

In addition to the chemical hazards discussed above, the following physical hazards may be present during the performance of the site activities.

- Slips, trips, and falls
- Cuts (or other injuries associated with hand tool use)
- Lifting (strain/muscle pulls)
- Burns [ERH Treatability Study (See Attachment VII)]
- Pinches and compressions
- Heavy equipment hazards (rotating equipment, hydraulic lines, etc.)
- Energized systems (contact with underground or overhead utilities)
- Vehicular and foot traffic (See Table 5-1)
- Noise in excess of 85 dBA
- Flying projectiles

Each of these physical hazards is discussed in greater detail in Section 4.0 of the TtNUS health and Safety Guidance Manual. Additionally, information on the associated control measures for these hazards are discussed in Table 5-1 of this HASP. Some of these hazards and the associated control measures are discussed below due to the emphasis on incident and injury history.

6.2.1 Slips, Trips, and Falls

Conditions such as steep terrain and/or heavy vegetation may create an increased potential for slip, trip, and fall hazards.

- The safest approach to sample points will be identified and cleared to permit field crew access to sample locations.
- Establish anchor points and rope handrails for traversing/ascending/descending angles and slopes greater than 45% grade.
- Footwear with an adequate traction.
- Prepare work areas by removing tripping hazards (ruts, roots, debris). This is especially critical around rotating equipment, where a fall into the rotating apparatus could be life threatening.

6.2.2 Cuts or Other Injuries Associated with Hand Tool Use

The clearing of brush and vegetation will be performed using hand tools that may include machetes, and brush axes. The control measures presented below will help minimize the potential for physical and cutting hazards.

- Wear leather or heavy cotton work gloves when using tools to protect against blisters, cuts, or other hand injuries.
- Wear eye protection (safety glasses with side shields) to protect the eyes from twigs, sticks, or flying debris.
- Clear the immediate cutting area of personnel (radius of the tool swing area).
- Wear long pants and long-sleeved shirts to protect against abrasions.
- Wear hard hats if work will involve areas with overhead hazards (e.g., overhanging branches).
- Wear sturdy work boots.
- Inspect hand tools.
- Ensure that hand tools are sharp to facilitate cutting action. This will avoid persons forcing the tool to cut and increasing potential hazards.
- Use the proper tool for the intended purpose. The proper tool is the acetate tube retention tub recommended by Geoprobe. This will avoid potential injury possibly created through improper cutting procedures.

6.2.3 Energized Systems (Contact with Underground or Overhead Utilities)

Underground utilities such as pressurized lines, water, telephone, buried utility, and high voltage power lines may be present throughout the facility. Therefore, subsurface activities must be conducted following the requirements of the Tetra Tech NUS SOP for "Utility Locating and Excavation Clearance (HS-1.0)". A copy of this SOP is provided as Attachment IV. Clearance of underground and overhead utilities for each location will be coordinated with the Naval Station Great Lakes giving them a 15-Day advance notification.

Additionally, DPT operations will be conducted at a safe distance from overhead power lines as discussed in Attachment III (Minimum 20-feet). In certain cases, there may be a need to de-energize electrical cables using facility lockout/tagout procedures to insure electrical hazards are eliminated.

6.2.4 Strain/Muscle Pulls from Heavy Lifting

During execution of planned activities there is some potential for strains, sprains, and/or muscle pulls due to the physical demands and nature of this site work. To avoid injury during lifting tasks personnel are to

material or equipment use an appropriate number of personnel. Keep the work area free from clutter to avoid unnecessary twisting or sudden movements while handling loads.

The following steps will help prevent back injury:

- Clear the path you will follow.
- Lift with your legs, not your back.
- "Hug" the load. Minimize the horizontal distance between the load and your center of gravity.
- Avoid twisting.
- Break large loads into smaller, more manageable ones.
- Take frequent rest and stretch breaks.

6.2.5 Burns from ERH Sampling

During the sampling process employees may be exposed to split spoons with a temperature above 140 degrees F. To prevent possible thermal burns while handling split spoons field personnel will wear heavy duty cotton gloves and avoid any steam escaping from the borehole. Steam will not be under pressure and once steam escapes the borehole temperature will decrease rapidly above the surface of the boring.

6.2.6 Heavy Equipment Hazards (Pinch/Compression Points, Rotating Equipment, etc.)

Often the hazards associated with drilling operations are the most dangerous to be encountered during site activities. The SSO will discuss safe drilling procedures as part of site-specific training and/or during daily safety meetings using Safe Work Permits (Figure 10-1) presented in this HASP. The following rules will apply to drilling operations:

- Site personnel will be aware of the location and operation of this equipment.
- Each drill rig must be equipped with emergency stop devices, which will be tested daily to ensure that they are operational.
- Long handled shovels or equivalent shall be used to clear cuttings from the borehole and rotating equipment.

Additional requirements during drilling activities are discussed in Section 5.2 and in Table 5-1. The SSO will thoroughly discuss safe drilling procedures during the pre-activities training session. Site personnel will sign the form in Figure 8-1 documenting that they received the training and understand the procedures.

6.3 NATURAL HAZARD

Insect/animal bites and stings, poisonous plants, and inclement weather are natural hazards that may be present given the location of activities to be conducted.

6.3.1 Inclement Weather

Project tasks under this Scope of Work will be performed outdoors. As a result, inclement weather may be encountered. In the event that adverse weather conditions arise (electrical storms, hurricanes, etc.), the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

A NOAA Weather Radio is the best means to receive watches and warnings from the National Weather Service. The National Weather Service continuously broadcasts updated hurricane advisories that can be received by widely available NOAA Weather Radios.

7.0 HAZARD MONITORING – TYPES AND ACTION LEVELS

Direct reading instruments will be used at the sites to evaluate the presence of detectable site contaminants and other potentially hazardous conditions. As a result, specific air monitoring measures and requirements are established in Table 5-1 pertaining to the specific hazards and tasks of an identified operation. Additionally, the Health and Safety Guidance Manual, Section 1.0, contains detailed information regarding direct reading instrumentation, as well as general calibration procedures of various instruments.

7.1 INSTRUMENTS AND USE

Instruments will be used primarily to monitor source points and worker breathing zone areas, while observing instrument action levels. Action levels are discussed in Table 5-1 as they may apply to a specific task or location.

7.1.1 Photoionization Detector (PID)

In order to accurately monitor for any substances which may present an exposure potential to site personnel, a Photoionization Detector (PID) using a lamp energy of 11.7 eV or higher will be used. This instrument will be used to monitor potential source areas (boreholes, monitoring wells) and to screen the breathing zones of employees during site activities.

Prior to the commencement of any field activities, the background levels of the site must be determined and noted. Daily background readings will be taken away from any areas of potential contamination. These readings, any influencing conditions (i.e., weather, temperature, humidity) and site location must be documented in the field operations logbook or other site documentation (e.g., sample log sheet).

7.1.2 Hazard Monitoring Frequency

Table 5-1 presents the frequencies that hazard monitoring will be performed as well as the action levels which will initiate the use of elevated levels of protection. The SHSO may decide to increases these frequencies based on instrument responses and site observations. The frequency at which monitoring is performed will not be reduced without the prior consent of the PHSO or HSM.

7.2 INSTRUMENT MAINTENANCE AND CALIBRATION

Hazard monitoring instruments will be maintained and pre-field calibrated by the Tetra Tech NUS Equipment Manager and/or rental service employed. Operational checks and field calibration will be

performed on the instruments each day prior to their use. Field calibration will be performed on instruments according to manufacturer's recommendations (for example, the PID must be field calibrated daily and an additional field calibration must be performed at the end of each day to determine any significant instrument drift). These operational checks and calibration efforts will be performed in a manner that complies with the employees health and safety training, the manufacturer's recommendations, and with the applicable manufacturer standard operating procedure. Calibration efforts must be documented. Figure 7-1 is provided for documenting these calibration activities. This information may instead be recorded in a field operations logbook, provided that the information specified in Figure 7-1 is recorded. This required information includes the following:

- Date calibration was performed
- Individual calibrating the instrument
- Instrument name, model, and serial number
- Any relevant instrument settings and resultant readings (before and after) calibration
- Identification of the calibration standard (lot no., source concentration, supplier)
- Any relevant comments or remarks

7.3 DOCUMENTING INSTRUMENT READINGS

The SHSO is responsible for ensuring that monitoring instruments are used in accordance with the specifications of this HASP and with manufacturer's specifications/recommendations. In addition, the SHSO is also responsible for ensuring that the instrument use is documented. This requirement can be satisfied either by recording instrument readings on pre-printed sampling log sheets or in a field log book. This includes the requirement for documenting instrument readings that indicate no elevated readings above noted daily background levels (i.e., no-exposure readings). At a minimum, the SHSO must document the following information for each use of an air monitoring device:

- Date, time, and duration of the reading
- Site location where the reading was obtained
- Instrument used
- Personnel present at the area where the reading was noted
- Other conditions that are considered relevant to the SHSO (such as possible instrument interferences, etc.)

FIGURE 7-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: _____ **PROJECT NO.:** _____

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section specifies health and safety training and medical surveillance requirements for both Tetra Tech NUS and subcontractor personnel participating in on site activities.

8.1.1 Requirements For Tetra Tech NUS, Inc. and Subcontractor Personnel

Tetra Tech NUS and subcontractor personnel who will engage in field associated activities as described in this HASP must have:

- Completed 40 hours of introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e).
- Completed 8-Hour Refresher Training, if the identified persons had introductory training more than 12 months prior to site work.
- Completed 8-hour Supervisory training in accordance with 29 CFR 1910.120(e)(4), if their assigned function will involve the supervision of subordinate personnel.

Documentation of introductory training or equivalent work experience, supervisory, and refresher training as well as site-specific training will be maintained at the site. Copies of certificates or other official documentation will be used to fulfill this requirement.

8.2 SITE-SPECIFIC TRAINING

Tetra Tech NUS will provide site-specific training to Tetra Tech NUS employees and subcontractor personnel who will perform work on this project.

Figure 8-1 will be used to document the provision and content of the project-specific and associated training. Site personnel will be required to sign this form prior to commencement of site activities.

TtNUS will conduct a pre-activities training session prior to initiating site work. Additionally, a brief meeting will be held daily to discuss operations planned for that day. At the end of the workday, a short meeting may be held to discuss the operations completed and any problems encountered. This activity will be supported through the use of a Safe Work Permit System (See Section 10.2).

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements for Tetra Tech NUS and Subcontractor Personnel

Tetra Tech NUS and subcontractor personnel participating in project field activities will have had a physical examination. Physical examinations shall meet the minimum requirements of paragraph (f) of OSHA 29 CFR 1910.120. The physical examinations will be performed to ensure that personnel are medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained at the job site and made available, as necessary. Subcontractor personnel may use an alternative documentation for this purpose. The "Subcontractor Medical Approval Form" can be used to satisfy this requirement, or a letter from an officer of the company. The letter should state that the persons listed in the letter participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response." The letter should further state the following:

- The persons listed have had physical examinations under this program within the frequency as determined sufficient by their occupational health care provider
- Date of the exam
- The persons identified have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive- and negative- pressure respiratory protection.

A sample Subcontractor Medical Approval Form and form letter have been provided to eligible subcontractors in the Bid Specification package.

8.3.2 Medical Data Sheets

Each field team member, including subcontractors and visitors, entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet that is available in Attachment II of this HASP. This shall be provided to the SHSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTION

If through the execution of their contract elements the subcontractor will not enter the exclusion zone and there is no potential for exposure to site contaminants, subcontractor personnel may be exempt from the training and medical surveillance requirements with the exception of Section 8.2. Examples of

subcontractors who may qualify as exempt from training and medical surveillance requirements may include surveyors who perform surveying activities in site perimeter areas or areas were there is no potential for exposure to site contaminants and support or restoration services. **Use of this Subcontractor Exception is strictly limited to the authority of the CLEAN Health and Safety Manager.**

FIGURE 8-1

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing field investigation activities at Naval Station Great Lakes, Illinois and that I have received site-specific training that included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Incipient response procedures
- Review of the contents of relevant Material Safety Data Sheets
- Review of the use of Safe Work Permits

I have been given the opportunity to ask questions and that my questions have been answered to my satisfaction and that the date of my training and my medical surveillance requirements indicated below are accurate.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

9.0 SPILL PREVENTION AND CONTAINMENT PROGRAM

9.1 SCOPE AND APPLICATION

This program applies to the single or aggregate accumulation of bulk storage materials (over 55-gallons). As the classification of certain materials such as IDW is unknown, these materials will be treated as hazardous, pending laboratory certification to the contrary. The types of materials for which this program will apply are as follows:

- Investigative Derived Wastes (IDW) such as decontamination fluids, soil cuttings, and purge and well development waters
- Resource Storage – Limited fuel and lubricant storage

The spill containment and control will be engaged any time there is a release of the above-identified materials from a containment system or vessel. This spill containment program will be engaged in order to minimize associated hazards.

9.2 POTENTIAL SPILL AREAS

Potential spill areas will be periodically monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, limited areas are vulnerable to this hazard including:

- Resource deployment
- Waste transfer
- Central staging

It is anticipated that the IDW generated as a result of this scope of work will be containerized, labeled, and staged to await further analyses. The results of these analyses will determine the method of disposal.

9.3 CONTAINMENT AREAS

In order to facilitate leak and spill inspection and response, and to minimize potential hazards which may impact the integrity of the storage containers, the staging area for these substances will be structured as follows:

9.3.1 IDW

- 55 Gallon Drums (United Nations 1A2 configurations) – 4 Drums to a Pallet; labels and the retaining ring bolt and nut on the outside of each drum to facilitate easy access; minimum 4-feet between each row of pallets. If necessary, a bermed and lined area will be constructed.

- Storage Tank – Polyethylene Construction – Tank shall be placed into a bermed enclosure of sufficient size to accommodate 110% of anticipated volume (largest container plus 10% for rainwater and container displacement).

- Roll-off Container – A roll-off container will be used for soil. The roll-off will be covered during off hours.

Regardless of container types selected, the staging area will be identified as a Satellite Storage Area with proper signage, points of contact in the event of an emergency, alternate contacts, and identification of stored material (i.e., purge or decontamination waters, soil cuttings, etc.).

An Inventory Log will be maintained by the FOL regarding types of IDW and volumes generated. An updated Inventory List will be provided by the FOL to the designated Emergency Response Agency or Base Contact during days off and between shifts or phases of operations.

9.3.2 Flammable/POL Storage

Flammable Storage [i.e., fuels, decontamination solvents (Isopropanol)] and Petroleum/oil/lubricants (POL) will require proper dispensing containers and necessary storage for cumulative volumes in excess of 25 gallons. Storage and dispensing will comply with the following requirements:

- The fuels, which will be stored and dispensed from portable containers, will utilize safety cans.
- Portable hand held storage containers will be labeled per Hazard Communication requirements.
- Larger volumes stored for fueling equipment will be stored in approved mobile above ground storage tanks with secondary containment capable of holding the tank volume plus 10%.
- Portable flammable liquid storage tanks will be properly grounded and will have bonding capabilities for the transfer of loading and off-loading of its contents.
- Dispensing locations will be supported by a fire extinguisher positioned no closer than 50 feet from the storage tank, properly mounted and identified.
- The storage location will be well marked with proper signage, protective bumper poles and will have straight through access/egress for vehicles.

9.4 MATERIALS HANDLING

To minimize the hazards associated with moving drums and containers (i.e, lifting, pinch and compression points) material handling will be supported in the following manner:

- A drum cart with pneumatic tires will be used, if drums are used for IDW storage. This cart will be used to relocate drums within the staging and satellite storage location.

- In addition, a mechanized means such as a suitably equipped skid loader or back-hoe will be provided to move IDW containers from the field location to the staging and satellite storage location. This piece of equipment will also be used in site clearance and restoration as deemed appropriate and necessary.

Other means of material handling will be evaluated by the SHSO based on their ability to minimize or eliminate material handling hazards.

9.5 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic walk-around by the personnel staging or disposing of drums or in the Resource Deployment area will be conducted during working hours to visually determine that storage vessels are not leaking. If a leak is detected, the FOL will be notified and the Spill Containment/Control Response Plan as specified in Section 9.8 will be engaged. Inspections will be documented in the project logbook.

9.6 PERSONNEL TRAINING AND SPILL PREVENTION

Personnel will be instructed in the procedures for incipient spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL and/or the SHSO will serve as the Spill Response Coordinators for this operation, should the need arise. Personnel through the course of this project will be drilled as part of testing the EAP.

9.7 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment that will always be maintained at the staging areas the purpose of supporting this Spill Containment/Control Plan.

- Sand, clean fill, vermiculite, or other non combustible absorbent (Oil-dry)
- Extra Drums (55-gallon U.N. 1A2) should the need to transfer material from leaking containers arise.

- Pumps (gas or electric necessary for transferring liquids from leaking containers)/tubing
- Shovels, rakes, and brooms
- Container labels
- Personal Protective Equipment
  - Nitrile outer gloves
  - Splash Shield
  - Impermeable over-boots
  - Rain suit

9.8 SPILL CONTAINMENT/CONTROL RESPONSE PLAN

This section describes the procedures the Tetra Tech NUS field personnel will employ upon the detection of a spill or leak.

- Notify the SHSO or FOL immediately upon detection of a leak or spill. Activate emergency alerting procedures for that area to remove non-essential personnel.

- Employ the personal protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the container or raising the leak to the highest point in the vessel. Spread the absorbent material in the area of the spill, covering it completely.

- Transfer the material to a new vessel; collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment and disposal options.

- Re-containerize spills, including 2-inch of top cover (if over soils) impacted by the spill. Await test results for treatment or disposal options.

It is not anticipated that a spill will occur that the field crew cannot handle. Should this occur, notification of the appropriate Emergency Response agencies will be carried out by the FOL or SSO in accordance with the procedures specified in Section 2.0 of this HASP.

10.0 SITE OPERATIONS AND CONTROL

Site operations and control will be facilitated through the use of established work zones and security and control of those zones. These activities will minimize the impact and spread of contaminants brought to the surface through subsurface investigative methods as well as protect personnel and visitors within these zones during ongoing operations.

10.1 WORK ZONES

Tetra Tech NUS will delineate and use work zones in conjunction with decontamination procedures to prevent the spread of contaminants to other areas of the site. A three-zone approach will be used for work at this site; an Exclusion Zone, a Contamination Reduction Zone, and a Support Zone. These will be used to control access to the work areas, restricting the general public, avoiding potentials to spread any contaminants, and to protect individuals who are not cleared to enter by way of training and/or medical surveillance qualifications.

10.1.1 Exclusion Zone

An Exclusion Zone will be established at each sampling point/location. The purpose of the exclusion zone is to define a area where a more rigorous protocol for workers within what is determined to be an impact area. The impact area is that area which could be adversely impacted by either chemical or physical hazards. Exclusion zone size and dimensions will vary based on activities. Impact areas dimensions will be influenced by the following considerations:

- Physical and topographical features of the site
- Weather conditions
- Field and analytical measurements of air and environmental contaminants
- Air dispersion calculations
- Potential for explosion and dispersion
- Physical, chemical and toxicological properties of the contaminants being investigated
- Tasks to be conducted
- Decontamination procedures
- Potential for exposure

As conditions change the dimensions of the exclusion zone will change. However, the following dimensions represent a starting point from which the exclusion zones will be expanded:

- DPT/HSA - Soil Boring. The exclusion zone for this activity will be set at the height of the mast, plus five feet surrounding the point of operation, with a minimum of 25-feet. This distance will also apply when subsurface soil sampling from behind these type rigs.

- Monitoring well development, sampling, groundwater level measurements. The exclusion zone for this activity will be set at 10-feet surrounding the well head and discharge collection container.

- Surface soils, groundwater and IDW sampling. The exclusion zone for this activity will be set at 5-feet surrounding the point of operation.

- Decontamination operation. The exclusion zone for this activity will be set at 25 feet surrounding the gross contamination wash and rinse as well as 25-feet surrounding the heavy equipment decontamination area.

- Investigative Derived Waste (IDW) area will be constructed and barricaded. Only authorized personnel will be allowed access.

Exclusion zones shall remain marked until the SHSO has evaluated the restoration effort and has authorized changing the zone status.

Exclusion zones will be marked using barrier tape, traffic cones and/or drive poles. Signs will be posted to inform and direct site personnel and site visitors.

10.1.2 Contamination Reduction Zone

The contamination reduction zone will be split to represent two separate functions. The first function will be a control/supply point for supporting exclusion zone activities. The second function, which may take place a sufficient distance from the exclusion zone is the decontamination of personnel and heavy equipment.

In order to move from the exclusion zone to a separate location the following activities will be used:

- As samplers move from location to location during sampling activities, dedicated sampling devices and PPE will be washed of gross contamination, removed, separated, and bagged. Personnel will use hygienic wipes, such as Handy Wipes, as necessary for personnel decontamination until they can access the centralized decontamination unit. At the first available opportunity personnel will wash their face and hands. This is critical prior to breaks and lunch when contamination can be transferred to the mouth through hand to mouth contact.

- Upon completion of the assigned tasks the personnel will move through the central decontamination area to clean reusable PPE and field equipment. Based on ambient conditions medical evaluations may take place at the termination point of the decontamination line. These evaluations will include pulse rate, oral temperature, breathing rate to evaluate physiological demands on site personnel. As stated earlier, these evaluations will be based on ambient conditions and acclimation periods.

10.1.3 Support Zone

The Support Zone will consist of a field trailer, storage, lay-down areas, or some other uncontaminated, controlled point. The Support Zone for this project will include a staging area where site vehicles can be parked, equipment will be unloaded, and where food and drink containers will be maintained. The support zones will be established in clean areas of the site.

10.2 SAFE WORK PERMITS

Exclusion Zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task by task basis. An example of the Safe Work Permit is included in Figure 10-1. The daily meetings conducted by the FOL/SHSO will further support these work permits. The use of these permits will ensure that site-specific considerations and changing conditions are incorporated into the planning effort. Safe Work Permits will require the signatures of either the FOL or the SHSO. Personnel engaged in on-site activities must be made aware of the elements indicating levels of protection and precautionary measures to be used.

The use of these permits will establish and provide for reviewing protective measures and hazards associated with each operation. This HASP will be used as the primary reference for selecting levels of protection and control measures. The Safe Work Permit will take precedence over the HASP when more conservative measures are required based on specific site conditions.

FIGURE 10-1
SAFE WORK PERMIT

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** _____

II. **Primary Hazards:** Potential hazards associated with this task include _____

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____ TtNUS

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐
Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒
Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☐ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type –)	☐ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Steel toe Work shoes or boots	☐ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** _____

Permit Issued by: _____ Permit Accepted by: _____

Upon completion of the work for which the Safe Work Permit was assigned, the Safe Work Permit will be turned into the FOL or the SHSO. Concerns, complaints, and suggestions may be made on the reverse of the Safe Work Permit for consideration by the FOL and/or the SHSO. Permits turned in with suggestions, difficulties, or complaints will be forwarded to the PHSO for review.

The Safe Work Permit and the HASP will serve as the primary reference for work place evaluations and audits conducted to determine if the task is being conducted under the direction conveyed by the HASP and the Safe Work Permit.

10.3 SITE MAP

Once the areas of contamination, access routes, topography, dispersion routes are determined, a site map will be generated and adjusted as site conditions change. This map will be posted to illustrate up-to-date information of contaminants and adjustment of zones and access points. This map will be posted at the field support trailer.

10.4 BUDDY SYSTEM

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of the personnel involved in this operation.

10.5 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

Tetra Tech NUS personnel will provide MSDSs for chemicals brought on-site. The contents of these documents will be reviewed by the SHSO with the user(s) of the chemical substances prior to any actual use or application or the substances on-site. The MSDSs will be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request. The SHSO will be responsible for implementing a site-specific Hazard Communication Program (See Section 5.0 of the TtNUS Health and Safety Guidance Manual). This includes collection of MSDSs, creation and maintenance of an accurate Chemical Inventory Listing, addressing container labeling and personnel training issues, and other aspects of Hazard Communication.

10.6 COMMUNICATION

It is anticipated that site personnel will be working in close proximity during proposed field activities. In the event that site personnel are in isolated areas or are separated by significant distances, a supported

means of communication between field crews will be utilized. Two-way radio communication devices, if needed, will be used only with Naval Station Great Lakes approval.

External communications will be accomplished utilizing telephones at predetermined and approved locations or through cellular phones. External communication will primarily be used for the purpose of resource and emergency resource communications. Prior to the commencement of site activities, the FOL will determine and arrange for telephone communications, if it is determined a cellular means will not be used.

10.7 SITE VISITORS

Potential site visitors that may be encountered during the performance of the field work could include the following:

- Personnel invited to observe or participate in operations by Tetra Tech NUS.
- Regulatory personnel (i.e., DOD, IL EPA, U.S. EPA, OSHA, etc.)
- Southern Division Navy personnel
- Other authorized visitors

Non-DOD personnel working on this project are required to gain initial access to the base by coordinating with the TtNUS TOM or designee and following established base access procedures.

Once access to the base is obtained, personnel who require access to Tetra Tech NUS work sites (areas of ongoing operations) will be required to obtain permission from the FOL and the Base Contact. Upon gaining access to the work site, site visitors wishing to observe operations in progress will be required to meet the minimum requirements as stipulated below.

- Site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individuals name (proper identification required), who they represent, and the purpose for the visit. The FOL is responsible for ensuring that site visitors are always escorted while on site.

- Site visitors will be required to produce the necessary information supporting clearance on to the site. This includes information attesting to applicable training (40-hours of HAZWOPER training required for Southern Division Navy Personnel), and medical surveillance as stipulated in Section 8.3, of this document. In addition, to enter the sites operational zones during planned activities, visitors will be

required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items they will be permitted to enter the site and applicable operational areas. Visitors are required to observe the protective equipment and site restrictions in effect at the work areas visited. Any visitors not meeting the requirements as stipulated in this plan for site clearance will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause on-site activities to be terminated until that visitor can be removed. Removal of unauthorized visitors will be accomplished with support form the Base Contact, if necessary. At a minimum, the Base Contact will be notified of any unauthorized visitors.

10.8 SITE SECURITY

As this activity will take place at a Navy facility, the first line of security will be provided by the base gate restricting the general public. The second line of security will take place at the work site referring interested parties to the FOL and Base Contact.

Security at the work areas will be accomplished using field personnel. This is a multiple person operation, involving multiple operational zones. Tetra Tech NUS personnel will retain complete control over active operational zones. The Base Contact will serve as the focal point for base personnel and interested parties and will serve as the primary enforcement contact.

11.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that confined space and permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces.** A confined space is defined as an area which has the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the PHSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed, and the HSM will have to be notified.

12.0 MATERIALS AND DOCUMENTATION

The TtNUS FOL shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for chemicals brought on site, including decontamination solutions, fuels, sample preservatives, calibration gases, etc.
- A full-size OSHA Job Safety and Health Poster (posted in the site trailers)
- Training/Medical Surveillance Documentation Form (Blank)
- Emergency Reference Information (Section 2.0, extra copy for posting)

12.1 MATERIALS TO BE POSTED OR MAINTAINED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations where posting these documents is not feasible, (such as no office trailer), these documents should be separated and immediately accessible.

Chemical Inventory Listing (posted) - This list represents chemicals brought on-site, including decontamination solutions, sample preservations, fuel, etc.. This list should be posted in a central area.

MSDSs (maintained) - The MSDSs should also be in a central area accessible to site personnel. These documents should match the listings on the chemical inventory list for substances used on-site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster (posted) - this poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

Site Clearance (maintained) - This list is found within the training section of the HASP (See Figure 8-2). This list identifies site personnel, dates of training (including site-specific training), and medical surveillance. The lists indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) (posted) - This list of numbers and directions will be maintained at the phone communications points and in each site vehicle.

Medical Data Sheets/Cards (maintained) - Medical Data Sheets will be filled out by on-site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. A copy of this sheet or a wallet card will be given to personnel to be carried on their person.

Hearing Conservation Standard (29 CFR 1910.95) (posted) - this standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring (maintained) - The results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels (maintained) - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using Department of Transportation (DOT) placards and acceptable (Hazard Communication 29 CFR 1910.1200(f)) labels.

The purpose of maintaining or posting this information, as stated above, is to allow site personnel quick access. Variations concerning location and methods of presentation are acceptable, providing the objection is accomplished.

13.0 GLOSSARY

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air Purifying Respirators
AOC	Area of Concern
CERCLA	Comprehensive Environmental Response Compensation, and Liability Act
CFR	Code of Federal Regulations
CNS	Central Nervous System
CRZ	Contamination Reduction Zone
CTO	Contract Task Order
DOD	Department of Defense
DOT	Department of Transportation
DPT	Direct-Push Technology
EPA	Environmental Protection Agency
FFA	Federal Facilities Agreement
eV	Electron Volts
FID	Flame Ionization Detector
FOL	Field Operations Leader
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HSM	Health and Safety Manager
IDW	Investigation-derived Waste
LEL/O_2	Lower Explosive Limit/Oxygen
MSDS	Material Safety Data Sheet
N/A	Not Available
NAS	Naval Air Station
NIOSH	National Institute Occupational Safety and Health
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PID	Photo Ionization Detector
PPE	Personal Protective Equipment
RIFS	Remedial Investigation and Feasibility Study

SAP	Sampling and Analysis Plan
SCBA	Self Contained Breathing Apparatus
SOPs	Standard Operating Procedures
SHSO	Site Health and Safety Officer
STEL	Short Term Exposure Limit
SVOC	Semi-volatile Organic Compounds
TOM	Task Order Manager
TPH	Total Petroleum Hydrocarbons
TtNUS	Tetra Tech NUS, Inc.
TWA	Time Weighted Average
USTs	Underground Storage Tanks
UV	Ultra Violet

ATTACHMENT I

INJURY/ILLNESS PROCEDURE AND REPORT FORM

TETRA TECH NUS, INC.

INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

WHAT YOU SHOULD DO IF YOU ARE INJURED OR DEVELOP AN ILLNESS AS A RESULT OF YOUR EMPLOYMENT:

- Stop work as needed to ensure no further harm is done.
- If injury is minor, obtain appropriate first aid treatment.
- If injury or illness is severe or life threatening, obtain professional medical treatment at the nearest hospital emergency room. Check with your office location or project health and safety plan for specific instructions.
- If incident involves an injury, illness, or chemical exposure on a project work site, follow instructions in the Health & Safety Plan.
- Immediately report any injury or illness to your supervisor or office manager. In addition, you must contact your Human Resources representative, Marilyn Duffy at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours of the injury. You will be required to complete an Injury/Illness Report. You may also be required to participate in a more detailed investigation with the Health Sciences Department.
- In the event of a serious near-miss incident, a "Serious Near Miss Report" (Form AR-2, available online at https://go2.tetratech.com under "Departments", "Health and Safety", "Accident Reporting Procedures", hyperlink for "Serious Near Miss Report") must be completed and faxed to the Corporate Health and Safety Manager within 48 hours.
- If further medical treatment is needed, our insurance carrier, ACE, will provide information on the authorized providers customized to the location of the injured employee. You can find this information by accessing the website of ACE's claims handler, ESIS, at : **www.esis.com**. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local Human Resources representative (Marilyn Duffy), Corporate Health and Safety Manager (Matt Soltis), or Corporate Administration in Pasadena, California, at (626) 351-4664.

Worker's compensation is a state-mandated program that provides medical and disability benefits to employees who become disabled due to job related injury or illness. Tetra Tech, Inc. and its subsidiaries pay premiums on behalf of their employees. This program is based on a no-fault system, and benefits are provided for covered events as an exclusive remedy to the injured employee regardless of fault. The types of injuries or illnesses covered and the amount of

benefits paid are regulated by the state worker's compensation boards and vary from state to state. Corporate Administration in Pasadena is responsible for administering the Company's worker's compensation program. The following is a general explanation of worker's compensation provided in the event that you become injured or develop an illness as a result of your employment with Tetra Tech or any of its subsidiaries. Please be aware that the term used for worker's compensation varies from state to state.

WHO IS COVERED:

All employees of Tetra Tech, whether they are on a full-time, part-time or temporary status, working in an office or in the field, are entitled to worker's compensation benefits from the first day of work. All employees must follow the above injury/illness reporting procedures. If you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

Consultants, independent contractors, and employees of subcontractors and employees from temporary employment agencies are not covered by Tetra Tech's Worker's Compensation plan.

WHAT IS COVERED:

If you are injured or develop an illness caused by your employment, worker's compensation benefits are available to you subject to the laws of the state you work in. Injuries do not have to be serious; even injuries treated by first aid practices are covered and must be reported.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT

To: _____
Subsidiary Health and Safety Representative

cc: _____
Workers Compensation Administrator

Project name: _____

Project number: _____

Prepared by: _____

Position: _____

Office: _____

Telephone number: _____

Fax number: _____

Information Regarding Injured or Ill Employee

Name: _____ Office: _____

Home address: _____ Gender: M ☐ F ☐ No. of dependents: _____

_____ Marital status: _____

Home telephone number: _____ Date of birth: _____

Occupation (regular job title): _____ Social security number: _____

Department: _____

Date of Accident: _____ **Time of Accident:** _____ a.m. ☐ p.m. ☐

Time Employee Began Work: _____ ☐ Check if time cannot be determined

Location of Incident

Street address: _____

City, state, and zip code: _____

County: _____

Was place of accident or exposure on employer's premises? Yes ☐ No ☐

Information About the Incident

What was the employee doing just before the incident occurred? Describe the activity as well as the tools, equipment, or material the employee was using. Be specific. Examples: "Climbing a ladder while carrying roofing materials"; "Spraying chlorine from hand sprayer"; "Daily computer key-entry"

What Happened? Describe how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time"

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Information About the Incident (Continued)

What was the injury or illness? Describe the part(s) of the body affected and how it was affected. Be more specific than "hurt," "pain," or "sore." Examples "Strained back"; "Chemical burn, right hand"; "Carpal tunnel syndrome, left wrist"

Describe the Object or Substance that Directly Harmed the Employee: Examples: "Concrete floor"; "Chlorine"; "Radial arm saw." If this question does not apply to the incident, write "Not applicable."

Did the employee die? Yes ☐ No ☐ Date of death: _____

Was employee performing regular job duties? Yes ☐ No ☐

Was safety equipment provided? Yes ☐ No ☐ Was safety equipment used? Yes ☐ No ☐

Note: Attach any police reports or related diagrams to this report.

Witness (Attach additional sheets for other witnesses.)

Name: _____

Company: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Medical Treatment Required? ☐ Yes ☐ No ☐ First aid only

Name of physician or health care professional: _____

If treatment was provided away from the work site, provide the information below.

Facility name: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Was the employee treated in an emergency room? ☐ Yes ☐ No

Was the employee hospitalized over night as an in-patient? ☐ Yes ☐ No

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Corrective Action(s) Taken by Unit Reporting the Accident:

Corrective Action Still to be Taken (by whom and when):

Name of Tetra Tech employee the injury or illness was first reported to: _____

Date of Report: _____ **Time of Report:** _____

I have reviewed this investigation report and agree, to the best of my recollection, with its contents.

Printed Name of Injured Employee	Telephone Number
Signature of Injured Employee	Date

The signatures provided below indicate that appropriate personnel have been notified of the incident.

Title	Printed Name	Signature	Telephone Number	Date
Office Manager				
Project Manager				
Site Safety Coordinator or Office Health and Safety Representative				

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

To Be Completed by the Subsidiary Health and Safety Representative

Classification of Incident:

☐ Injury ☐ Illness

Result of Incident:

☐ First aid only

☐ Days away from work

☐ Remained at work but incident resulted in job transfer or work restriction

☐ Incident involved days away and job transfer or work restriction

☐ Medical treatment only

No. of days away from work _____

Date employee left work _____

Date employee returned to work _____

No. of days placed on restriction or job transfer: _____

OSHA Recordable Case Number _____

To Be Completed by Human Resources

Social security number: _____

Date of hire: _____ Hire date for current job: _____

Wage information: $ _____ per ☐ Hour ☐ Day ☐ Week ☐ Month

Position at time of hire: _____

Current position: _____ Shift hours: _____

State in which employee was hired: _____

Status: ☐ Full-time ☐ Part-time Hours per week: _____ Days per week: _____

Temporary job end date: _____

To Be Completed during Report to Workers' Compensation Carrier

Date reported: _____ Reported by: _____

Confirmation number: _____

Name of contact: _____

Field office of claims adjuster: _____

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

ATTACHMENT II

MEDICAL DATA SHEET

MEDICAL DATA SHEET

This Medical Data Sheet must be completed by all on-site personnel and kept in a central location during the execution of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project Naval Station Great Lakes, Great Lakes, Illinois CTO 0009

Name _____ Home Telephone _____

Address _____

Age _____ Height _____ Weight _____

Name of Next Kin _____

Drug or other Allergies _____

Particular Sensitivities _____

Do You Wear Contacts? _____

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals _____

_____

_____

What medications are you presently using? _____

_____

_____

Do you have any medical restrictions? _____

_____

_____

Name, Address, and Phone Number of personal physician: _____

_____

_____

I am the individual described above. I have read and understand this HASP.

_____ _____

Signature Date

ATTACHMENT III

EQUIPMENT INSPECTION CHECKLISTS

Equipment Inspection Checklist for Drill Rigs

Company:_____ **Unit/Serial No#:**_____

Inspection Date: ____/____/____ **Time:**____:____ **Equipment Type:**_____
(e.g, Drill Rigs Hollow Stem, Mud Rotary, Direct Push, HDD)

Project Name:_____ **Project No#:**_____

Yes	No	NA	Requirement	Comments
☐	☐	☐	Emergency Stop Devices • Emergency Stop Devices (At points of operation)	
☐	☐	☐	• Have all emergency shut offs identified been communicated to the field crew?	
☐	☐	☐	• Has a person been designated as the Emergency Stop Device Operator?	
☐	☐	☐	Highway Use • Cab, mirrors, safety glass?	
☐	☐	☐	• Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	
☐	☐	☐	• Seat Belts?	
☐	☐	☐	• Is the equipment equipped with audible back-up alarms and back-up lights?	
☐	☐	☐	• Horn and gauges	
☐	☐	☐	• Brake condition (dynamic, park, etc.)	
☐	☐	☐	• Tires (Tread) or tracks	
☐	☐	☐	• Windshield wipers	
☐	☐	☐	• Exhaust system	
☐	☐	☐	• Steering (standard and emergency)	
☐	☐	☐	• Wheel Chocks?	
☐	☐	☐	• Are tools and material secured to prevent movement during transport? Especially those within the cab?	
☐	☐	☐	• Are there flammables or solvents or other prohibited substances stored within the cab?	
☐	☐	☐	• Are tools or debris in the cab that may adversely influence operation of the vehicle (in and around brakes, clutch, gas pedals)	

Yes	No	NA	Requirement	Comments
☐	☐	☐	Fluid Levels: • Engine oil	
☐	☐	☐	• Transmission fluid	
☐	☐	☐	• Brake fluid	
☐	☐	☐	• Cooling system fluid	
☐	☐	☐	• Hoses and belts	
☐	☐	☐	• Hydraulic oil	
☐	☐	☐	High Pressure Hydraulic Lines • Obvious damage	
☐	☐	☐	• Operator protected from accidental release	
☐	☐	☐	• Coupling devices, connectors, retention cables/pins are in good condition and in place	
☐	☐	☐	Mast Condition • Structural components/tubing	
☐	☐	☐	• Connection points	
☐	☐	☐	• Pins	
☐	☐	☐	• Welds	
☐	☐	☐	• Outriggers	
☐	☐	☐	• Operational	
☐	☐	☐	• Plumb (when raised)	
☐	☐	☐	Hooks • Are the hooks equipped with Safety Latches?	
☐	☐	☐	• Does it appear that the hook is showing signs of wear in excess of 10% original dimension?	
☐	☐	☐	• Is there a bend or twist exceeding 10% from the plane of an unbent hook?	
☐	☐	☐	• Increase in throat opening exceeding 15% from new condition	
☐	☐	☐	• Excessive nicks and/or gouges	
☐	☐	☐	• Clips	
☐	☐	☐	• Number of U-Type (Crosby) Clips (cable size 5/16 – 5/8 = 3 clips minimum) (cable size 3/4 – 1 inch = 4 clips minimum) (cable size 1 1/8 – 1 3/8 inch = 5 clips minimum)	

Yes	No	NA	Requirement	Comments
☐	☐	☐	Power cable and/or hoist cable • Reduction in Rope diameter (5/16 wire rope>1/64 reduction nominal size -replace) (3/8 to 1/2 wire rope>1/32 reduction nominal size-replace) (9/16 to 3/4 wire rope>3/64 reduction nominal size-replace) • Number of broken wires (6 randomly broken wires in one rope lay) (3 broken wires in one strand) • Number of wire rope wraps left on the Running Drum at nominal use (≥3 required) - Lead (primary) sheave is centered on the running drum • Lubrication of wire rope (adequate?) • Kinks, bends – Flattened to > 50% diameter	
☐	☐	☐	Hemp/Fiber rope (Cathead/Split Spoon Hammer) • Minimum ¾; maximum 1 inch rope diameter (Inspect for physical damage) • Rope to hammer is securely fastened	
☐	☐	☐	Safety Guards – • Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact? • Hot pipes and surfaces exposed to accidental contact? • High pressure lines • Nip/pinch points	
☐	☐	☐	Operator Qualifications • Does the operator have proper licensing where applicable, (e.g., CDL)? • Does the operator, understand the equipment's operating instructions? • Is the operator experienced with this equipment? • Is the operator 21 years of age or more?	

Yes	No	NA	Requirement	Comments
☐	☐	☐	PPE Required for Drill Rig Exclusion Zone • Hardhat	
☐	☐	☐	• Safety glasses	
☐	☐	☐	• Work gloves	
☐	☐	☐	• Chemical resistant gloves_____	
☐	☐	☐	• Steel toed Work Boots	
☐	☐	☐	• Chemical resistant Boot Covers	
☐	☐	☐	• Apron	
☐	☐	☐	• Coveralls Tyvek, Saranex, cotton)_____	
☐	☐	☐	Other Hazards • Excessive Noise Levels? _____dBA	
☐	☐	☐	• Chemical hazards (Drilling supplies - Sand, bentonite, grout, fuel, etc.)	
☐	☐	☐	- MSDSs available?	
☐	☐	☐	• Will On-site fueling occur	
☐	☐	☐	- Safety cans available?	
☐	☐	☐	- Fire extinguisher (Type/Rating -_____ _)	

Approved for Use ☐ Yes ☐ No ☐ See Comments

_____ _____

Site Health and Safety Officer Operator

ATTACHMENT IV

STANDARD OPERATING PROCEDURE
FOR
UTILITY LOCATING AND
EXCAVATION CLEARANCE

TABLE OF CONTENTS

1.0 PURPOSE

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations. Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility locating services. It is the policy of Tetra Tech NUS, Inc. (TtNUS) to provide a safe and healthful work environment for the protection of our employees. The purpose of this Standard Operating Procedure (SOP) is to aid in achieving the objectives of this policy, to present the acceptable procedures pertaining to utility locating and excavation clearance activities, and to present requirements and restrictions relevant to these types of activities. This SOP must be reviewed by any employee potentially involved with underground or overhead utility locating and avoidance activities.

2.0 SCOPE

This procedure applies to all TtNUS field activities where there may be potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of typical methods used to determine the presence and avoidance of contact with utility services. This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to the initiation of any such activities on a specific project. This SOP is not intended to provide a detailed description of methodology and instrument operation. Specialized expertise during both planning and execution of several of the methods presented may also be required.

3.0 GLOSSARY

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Magnetometer – A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey – A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal Detection – A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

Vertical Gradiometer – A magnetometer equipped with two sensors that are vertically separated by a fixed distance. It is best suited to map near surface features and is less susceptible to deep geologic features.

Ground Penetrating Radar – Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture.

4.0 RESPONSIBILITIES

Project Manager (PM)/Task Order Manager (TOM) - Responsible for ensuring that all field activities are conducted in accordance with this procedure.

Site Manager (SM)/Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Site Health & Safety Officer (SHSO) – Responsible to provide technical assistance and verify full compliance with this SOP. The SHSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager (HSM) and to the PM/TOM.

Health & Safety Manager (HSM) – Responsible for preparing, implementing, and modifying corporate health and safety policy and this SOP.

Site Personnel – Responsible for performing their work activities in accordance with this SOP and the TtNUS Health and Safety Policy.

5.0 PROCEDURES

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed individually from a buried and overhead standpoint.

5.1 Buried Utilities

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown or incorrectly known on client properties. This procedure must be followed prior to beginning any subsurface probing or excavation that might potentially be in the vicinity of underground utility services. In addition, the Utility Clearance Form (Attachment 3) must be completed for every location or cluster of locations where intrusive activities will occur.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM/TOM is responsible for arranging for the procurement of a qualified, experienced, utility locating subcontractor who will accomplish the utility location and demarcation duties specified herein.

1. A comprehensive review must be made of any available property maps, blue lines, or as-builts prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities. Information regarding utility locations shall be added to project maps upon completion of this exercise.

2., A visual site inspection must be performed to compare the site plan information to actual field conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation or other subsurface activities must be marked at the site in white paint or pin flags to identify those locations of the proposed intrusive activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, electrical service vaults/panels, asphalt/concrete scares and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information regarding utility

locations shall be added to project maps upon completion of this exercise and returned to the PM/TOM.

3. If the planned work is to be conducted on private property (e.g., military installations, manufacturing facilities, etc.) the FOL must identify and contact appropriate facility personnel (e.g., public works or facility engineering) before any intrusive work begins to inquire about (and comply with) property owner requirements. It is important to note that private property owners may require several days to several weeks advance notice prior to locating utilities.

4. If the work location is on public property, the state agency that performs utility clearances must be notified (see Attachment 1). State "one-call" services must be notified prior to commencing fieldwork per their requirements. Most one-call services require, by law, 48- to 72-hour advance notice prior to beginning any excavation. Such services typically assign a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again. The utility service will notify utility representatives who then mark their respective lines within the specified time frame. It should be noted that most military installations own their own utilities but may lease service and maintenance from area providers. Given this situation, "one call" systems may still be required to provide location services on military installations.

5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other accepted means. The location of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code:

white	excavation/subsurface investigation location
red	electrical
yellow	gas, oil, steam
orange	telephone, communications
blue	water, irrigation, slurry
green	sewer, drain

6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., the work area must be thoroughly investigated prior to beginning the excavation. In these situations, utilities must be identified using safe and effective methods such as passive and intrusive surveys, or the use of non-conductive hand tools. Also, in situations where such hand tools are used, they should always be used in conjunction with suitable detection equipment, such as the items described in Section 6.0 of this SOP. Each method has advantages and disadvantages including complexity, applicability, and price. It also should be noted that in some states, initial excavation is required by hand to a specified depth.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment, and where utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed using a device such as a tile probe which is made of non-conductive material such as fiberglass. If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.

8. All utilities uncovered or undermined during excavation must be structurally supported to prevent potential damage. Unless necessary as an emergency corrective measure, TtNUS shall not make any repairs or modifications to existing utility lines without prior permission of the utility owner, property owner, and Corporate HSM. All repairs require that the line be locked-out/tagged-out prior to work.

5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be adequate to prevent employees from contacting such lines directly with any part of their body or indirectly though conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

Nominal Voltage	Minimum Clearance
0 -50 kV	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

6.0 UNDERGROUND LOCATING TECHNIQUES

A variety of supplemental utility locating approaches are available and can be applied when additional assurance is needed. The selection of the appropriate method(s) to employ is site-specific and should be tailored to the anticipated conditions, site and project constraints, and personnel capabilities.

6.1 Geophysical Methods

Geophysical methods include electromagnetic induction, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic induction, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References (Section 8.0).

Electromagnetic Induction

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is an EM-61.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

Magnetics

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

Ground Penetrating Radar

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

6.2 Passive Detection Surveys

Acoustic Surveys

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

Thermal Imaging

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting

debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

Hand Excavation

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other methods, borings and excavations may be cleared via the use of non-conductive hand tools. This should always be done in conjunction with the use of detection equipment. This would be required for all locations where there is a potential to impact buried utilities. The minimum hand-excavation depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the placement of buried utilities is influenced by frost line depths that vary by geographical region. Attachment 2 presents frost line depths for the regions of the contiguous United States. At a minimum, hand excavation depths must be at least to the frost line depth (see Attachment 2) plus two (2) feet, but never less than 4 feet below ground surface (bgs). For hand excavation, the hole created must be reamed large enough to be at least the diameter of the drill rig auger or bit prior to drilling. For soil gas surveys, the survey probe shall be placed as close as possible to the cleared hand excavation. It is important to note that a post-hole digger must not be used in this type of hand excavation activity.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, non-conductive tile probes may be used. A tile probe is a "T"-handled rod of varying lengths that can be pushed into the soil to determine if any obstructions exist at that location. Tile probes constructed of fiberglass or other nonconductive material are readily-available from numerous vendors. Tile probes must be performed to the same depth requirements as previously specified. As with other types of hand excavating activities, the use of a non-conductive tile probe, should always be in conjunction with suitable utility locating detection equipment.

7.0 INTRUSIVE ACTIVITIES SUMMARY

The following list summarizes the activities that must be performed prior to beginning subsurface activities:

1. Map and mark all subsurface locations and excavation boundaries using white paint or markers specified by the client or property owner.

2. Notify the property owner and/or client that the locations are marked. At this point, drawings of locations or excavation boundaries shall be provided to the property owner and/or client so they may initiate (if applicable) utility clearance.

   Note: Drawings with confirmed locations should be provided to the property owner and/or client as soon as possible to reduce potential time delays.

3. Notify "One Call" service. If possible, arrange for an appointment to show the One Call representative the surface locations or excavation boundaries in person. This will provide a better location designation to the utilities they represent. You should have additional drawings should you need to provide plot plans to the One Call service.

4. Implement supplemental utility detection techniques as necessary and appropriate to conform utility locations or the absence thereof.

5. Complete Attachment 3, Utility Clearance Form. This form should be completed for each excavation location. In situations where multiple subsurface locations exist within the close proximity of one another, one form may be used for multiple locations provided those locations are noted on the Utility Clearance Form. Upon completion, the Utility Clearance Form and revised/annotated utility location map becomes part of the project file.

8.0 REFERENCES

OSHA Letter of Interpretation, Mr. Joseph Caldwell, Attachment 4
OSHA 29 CFR 1926(b)(2)
OSHA 29 CFR 1926(b)(3)
TtNUS Utility Locating and Clearance Policy
TtNUS SOP GH-3.1; Resistivity and Electromagnetic Induction
TtNUS SOP GH-3.2; Magnetic and Metal Detection Surveys
TtNUS SOP GH-3.4; Ground-penetrating Radar Surveys

ATTACHMENT 1
LISTING OF UNDERGROUND UTILITY CLEARANCE RESOURCES

American Public Works Association
2345 Grand Boulevard, Suite 500, Kansas City, MO 64108-2625
Phone (816) 472-6100 • Fax (816) 472-1610
Web www.apwa.net • E-mail apwa@apwa.net

ONE-CALL SYSTEMS INTERNATIONAL CONDENSED DIRECTORY

Alabama
Alabama One-Call
1-800-292-8525

Alaska
Locate Call Center of Alaska, Inc.
1-800-478-3121

Arizona
Arizona Blue Stake
1-800-782-5348

Arkansas
Arkansas One Call System, Inc.
1-800-482-8998

California
Underground Service Alert North
1-800-227-2600
Underground Service Alert of Southern California
1-800-227-2600

Colorado
Utility Notification Center of Colorado
1-800-922-1987

Connecticut
Call Before You Dig
1-800-922-4455

Delaware
Miss Utility of Delmarva
1-800-282-8555

Florida
Sunshine State One-Call of Florida, Inc.
1-800-432-4770

Georgia
Underground Protection Center, Inc.
1-800-282-7411

Hawaii
Underground Service Alert North
1-800-227-2600

Idaho
Dig Line Inc.
1-800-342-1585
Kootenai County One-Call
1-800-428-4950
Shoshone - Benewah One-Call
1-800-398-3285

Illinois
JULIE, Inc.
1-800-892-0123
Digger (Chicago Utility Alert Network)
312-744-7000

Indiana
Indiana Underground Plant Protection Service
1-800-382-5544

Iowa
Iowa One-Call
1-800-292-8989

Kansas
Kansas One-Call System, Inc.
1-800-344-7233

Kentucky
Kentucky Underground Protection Inc.
1-800-752-6007

Louisiana
Louisiana One Call System, Inc.
1-800-272-3020

Maine
Dig Safe System, Inc.
1-888-344-7233

Maryland
Miss Utility
1-800-257-7777
Miss Utility of Delmarva
1-800-282-8555

Massachusetts
Dig Safe System, Inc.
1-888-344-7233

Michigan
Miss Dig System, Inc.
1-800-482-7171

Minnesota
Gopher State One Call
1-800-252-1166

Mississippi
Mississippi One-Call System, Inc
1-800-227-6477

Missouri
Missouri One-Call System, Inc.
1-800-344-7483

Montana
Utilities Underground Protection Center
1-800-424-5555
Montana One Call Center
1-800-551-8344

Nebraska
Diggers Hotline of Nebraska
1-800-331-5666

Nevada
Underground Service Alert North
1-800-227-2600

New Hampshire
Dig Safe System, Inc.
1-888-344-7233

New Jersey
New Jersey One Call
1-800-272-1000

New Mexico
New Mexico One Call System, Inc.
1-800-321-2537
Las Cruces- Dona Ana Blue Stakes
1-888-526-0400

New York
Dig Safely New York
1-800-962-7962
New York City- Long Island One Call Center
1-800-272-4480

North Carolina
The North Carolina One-Call Center, Inc.
1-800-632-4949

North Dakota
North Dakota One-Call
1-800-795-0555

Ohio
Ohio Utilities Protection Service
1-800-362-2764
Oil & Gas Producers Underground Protect'n Svc
1-800-925-0988

Oklahoma
Call Okie
1-800-522-6543

Oregon
Oregon Utility Notification Center/One Call Concepts
1-800-332-2344

Pennsylvania
Pennsylvania One Call System, Inc.
1-800-242-1776

Rhode Island
Dig Safe System, Inc.
1-888-344-7233

South Carolina
Palmetto Utility Protection Service Inc.
1-888-721-7877

South Dakota
South Dakota One Call
1-800-781-7474

Tennessee
Tennessee One-Call System, Inc.
1-800-351-1111

ATTACHMENT 1 (Continued)

Texas
Texas One Call System
1-800-245-4545
Texas Excavation Safety System, Inc.
1-800-344-8377
Lone Star Notification Center
1-800-669-8344

Utah
Blue Stakes of Utah
1-800-662-4111

Vermont
Dig Safe System, Inc.
1-888-344-7233

Virginia
Miss Utility of Virginia
1-800-552-7001
Miss Utility (Northern Virginia)
1-800-257-7777

Washington
Utilities Underground Location Center
1-800-424-5555
Northwest Utility Notification Center
1-800-553-4344
Inland Empire Utility Coordinating Council
509-456-8000

West Virginia
Miss Utility of West Virginia, Inc.
1-800-245-4848

Wisconsin
Diggers Hotline, Inc.
1-800-242-8511

Wyoming
Wyoming One-Call System, Inc.
1-800-348-1030
Call Before You Dig of Wyoming
1-800-849-2476

District of Columbia
Miss Utility
1-800-257-7777

Alberta
Alberta One-Call Corporation
1-800-242-3447

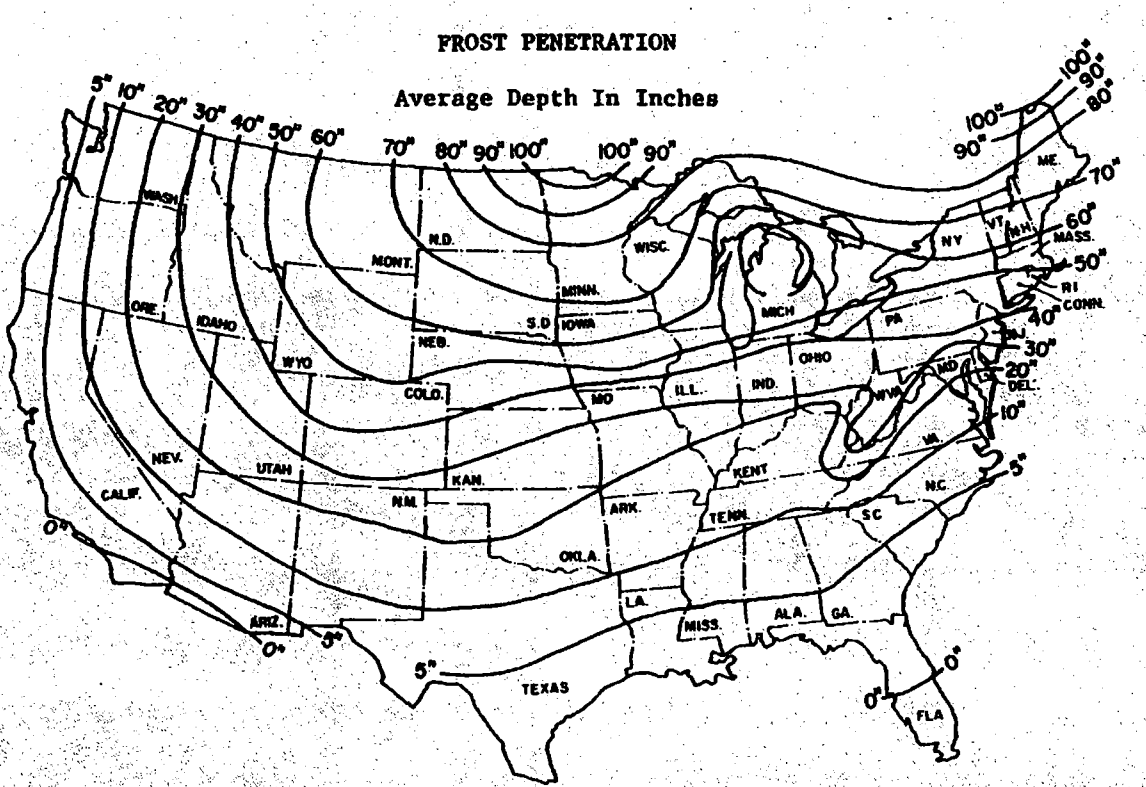
British Columbia
BC One Call
1-800-474-6886

Ontario
Ontario One-Call System
1-800-400-2255

Quebec
Info-Excavation
1-800-663-9228

ATTACHMENT 2

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



Courtesy U.S. Department Of Commerce

ATTACHMENT 3
UTILITY CLEARANCE FORM

Client: _____ Project Name: _____

Project No.: _____ Completed By: _____

Location Name: _____ Work Date: _____

Excavation Method/Overhead Equipment: _____

			Circle One
1.	Underground Utilities		
	a)	Review of existing maps?	yes no N/A
	b)	Interview local personnel?	yes no N/A
	c)	Site visit and inspection?	yes no N/A
	d)	Excavation areas marked in the field?	yes no N/A
	e)	Utilities located in the field?	yes no N/A
	f)	Located utilities marked/added to site maps?	yes no N/A
	g)	Client contact notified Name _____ Telephone: _____ Date: _____	yes no N/A
	g)	State One-Call agency called? Caller: _____ Ticket Number: _____ Date: _____	yes no N/A
	h)	Geophysical survey performed? Survey performed by: _____ Method: _____ Date: _____	yes no N/A
	i)	Hand excavation performed (with concurrent use of utility detection device)? Completed by: _____ Total depth: _____ feet Date: _____	yes no N/A
	j)	Trench/excavation probed? Probing completed by: _____ Depth/frequency: _____ Date: _____	yes no N/A

			Present Absent
2.	Overhead Utilities		
	a)	Determination of nominal voltage	yes no N/A
	b)	Marked on site maps	yes no N/A
	c)	Necessary to lockout/insulate/re-route	yes no N/A
	d)	Document procedures used to lockout/insulate/re-route	yes no N/A
	e)	Minimum acceptable clearance (SOP Section 5.2): _____	

3. Notes:

_____

_____

_____

Approval:

_____ _____

Site Manager/Field Operations Leader Date

c: PM/Project File
Program File

ATTACHMENT 4
OSHA LETTER OF INTERPRETATION

Mr. Joseph Caldwell
Consultant
Governmental Liaison
Pipeline Safety Regulations
211 Wilson Boulevard
Suite 700
Arlington, Virginia 22201

Re: Use of hydro-vacuum or non-conductive hand tools to locate underground utilities.

Dear Mr. Caldwell:

In a letter dated July 7, 2003, we responded to your inquiry of September 18, 2002, regarding the use of hydro-vacuum equipment to locate underground utilities by excavation. After our letter to you was posted on the OSHA website, we received numerous inquiries that make it apparent that aspects of our July 7 letter are being misunderstood. In addition, a number of industry stakeholders, including the National Utility Contractors Association (NUCA), have provided new information regarding equipment that is available for this work.

To clarify these issues, we are withdrawing our July 7 letter and issuing this replacement response to your inquiry.

Question: Section 1926.651 contains several requirements that relate to the safety of employees engaged in excavation work. Specifically, paragraphs (b)(2) and (b)(3) relate in part to the safety of the means used to locate underground utility installations that, if damaged during an uncovering operation, could pose serious hazards to employees.

Under these provisions, what constitutes an acceptable method of uncovering underground utility lines, and further, would the use of hydro-vacuum excavation be acceptable under the standard?

Answer

Background

Two sections of 29 CFR 1926 Subpart P (Excavations), 1926.651(Specific excavation requirements), govern methods for uncovering underground utility installations. Specifically, paragraph (b)(2) states:

> When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours * * * or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used. (emphasis added).

Paragraph (b)(3) provides:

ATTACHMENT 4 (Continued)

> When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means. (emphasis added).

Therefore, "acceptable means" must be used where the location of the underground utilities have not been identified by the utility companies and detection equipment is not used.

Subpart P does not contain a definition of either "other acceptable means" or "safe and acceptable means." The preambles to both the proposed rule and the final rule discussed the rationale behind the wording at issue. For example, the preamble to the proposed rule, 52 Fed. Reg. 12301 (April 15, 1987), noted that a 1972 version of this standard contained language that specified "careful probing or hand digging" as the means to uncover utilities. The preamble then noted that an amendment to the 1972 standard later deleted that language "to allow other, *equally effective means* of locating such installations." The preamble continued that in the 1987 proposed rule, OSHA again proposed using language in section (b)(3) that would provide another example of an acceptable method of uncovering utilities that could be used ***where the utilities have not been marked and detection equipment is not being used*** – "probing with hand-held tools." This method was rejected in the final version of 29 CFR 1926. As OSHA explained in the preamble to the final rule, 54 Fed. Reg. 45916 (October 31, 1989):

> OSHA received two comments * * * and input from ACCSH [OSHA's Advisory Committee on Construction Safety and Health] * * * on this provision. All commenters recommended dropping 'such as probing with hand-held tools' from the proposed provision, because this could create a hazard to employees by damaging the installation or its insulation.

In other words, the commenters objected to the use of hand tools being used unless detection equipment was used in conjunction with them. OSHA then concluded its discussion relative to this provision by agreeing with the commentators and ultimately not including any examples of "acceptable means" in the final provision.

Non-conductive hand tools are permitted

This raises the question of whether the standard permits the use of hand tools alone – without also using detection equipment. NUCA and other industry stakeholders have recently informed us that non-conductive hand tools that are appropriate to be used to locate underground utilities are now commonly available.

Such tools, such as a "shooter" (which has a non-conductive handle and a snub nose) and non-conductive or insulated probes were not discussed in the rulemaking. Since they were not considered at that time, they were not part of the class of equipment that was thought to be unsafe for this purpose. Therefore, we conclude that the use of these types of hand tools, when used with appropriate caution, is an "acceptable means" for locating underground utilities.

ATTACHMENT 4 (Continued)

Hydro-vacuum excavation

It is our understanding that some hydro-vacuum excavation equipment can be adjusted to use a minimum amount of water and suction pressure. When appropriately adjusted so that the equipment will not damage underground utilities (especially utilities that are particularly vulnerable to damage, such as electrical lines), use of such equipment would be considered a "acceptable means" of locating underground utilities. However, if the equipment cannot be sufficiently adjusted, then this method would not be acceptable under the standard.

Other technologies

We are not suggesting that these are the only devices that would be "acceptable means" under the standard. Industry stakeholders have informed us that there are other types of special excavation equipment designed for safely locating utilities as well.

We apologize for any confusion our July 7 letter may have caused. If you have further concerns or questions, please feel free to contact us again by fax at: U.S. Department of Labor, OSHA, Directorate of Construction, Office of Construction Standards and Compliance Assistance, fax # 202-693-1689. You can also contact us by mail at the above office, Room N3468, 200 Constitution Avenue, N.W., Washington, D.C. 20210, although there will be a delay in our receiving correspondence by mail.

Sincerely,

Russell B. Swanson, Director
Directorate of Construction

NOTE: OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA=s interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov.

ATTACHMENT V

HEARING CONSERVATION PROGRAM

TETRA TECH NUS, INC.

HEARING CONSERVATION PROGRAM

HEARING CONSERVATION
TABLE OF CONTENTS

TETRA TECH NUS, INC.
HEARING CONSERVATION PROGRAM

1.0 PURPOSE

To establish general and site-specific hearing conservation procedures and guidelines.

2.0 SCOPE

Applies to all hazardous waste and other field activities where exposure to high levels of noise may occur. This program is designed to comply with OSHA General Industry Standard 29 CFR 1910.95.

3.0 RESPONSIBILITIES

Project Health and Safety Officer (PHSO) - The PHSO shall ensure that hearing conservation measures are adequately addressed in the Site Specific Health and Safety Plan.

Site Safety Officer (SSO) - The SSO is responsible for establishing and implementing a hearing conservation program. The SSO also ensures that adequate procedures are followed to prevent excessive exposure of individuals to high levels of noise.

Project Manager (PM) - The PM will ensure that sufficient information has been provided to the PHSO to prepare adequate procedures for inclusion in the site-specific Health and Safety Plan (HASP). The PM is also ultimately responsible for the effective compliance with these requirements.

4.0 MONITORING AND ESTABLISHING HIGH-NOISE AREAS

4.1 The SSO, as necessary, will perform and initial noise survey on Tetra Tech NUS and Subcontractors operations and work areas by the use of a sound meter and/or dosimetry. All monitoring will be done in accordance with 29 CFR 1910.95. Areas and operations which are expected to reach or exceed 85 decibels (dBA) will be required to adhere to the requirements for this program.

4.2 The HASP will set policy on mandatory use of hearing protection in affected areas, and while performing certain operations. The FOL and/or SSO will notify all Tetra Tech NUS and Subcontractor personnel of high noise areas and operations prior to work initiation.

The FOL and/or the SSO will be responsible for implementation and enforcement of the site-specific Hearing Conservation elements.

4.3 The FOL and/or the SSO will post or otherwise identify areas of operations which exceed 85 dBA. If significant changes in noise levels occur (such as a shutdown in an operating unit, change in procedures), the noise levels shall be re-evaluated by the SSO to determine if hearing protection will be worn.

5.0 HEARING PROTECTION

Each employee will have the opportunity to choose from a variety of hearing protection devices. Hearing protectors shall be replaced as necessary. The SSO will evaluate the attenuation factors of hearing protection devices and will select appropriate types based on sound level monitoring or personal dosimetry.

6.0 TRAINING PROGRAM

The Health Sciences Department will institute and maintain an initial training program for new employees and provide an annual training program for employees who may be exposed to noise sources 85 dBA or greater. The annual training will be incorporated with the refresher health and safety training curricula. All affected employees will be involved in the program and their participation documented.

6.1 The training program shall include the effects of noise on hearing. It will also include the purpose of hearing protectors; the advantages, disadvantages, and attenuation factors of the various types. Instruction shall be given on issue points, selection, fitting, use and care of hearing protectors.

6.2 A copy of the OSHA Noise Standard and applicable informational and training material will be available to all employees.

7.0 RECORDKEEPING

Exposure measurements, related records will be kept at the site. Record retention will be done in accordance with the time periods stated in 29 CFR 1910.95 and 1910.20.

8.0 ATTACHMENTS

8.1 29 CFR 1910.95 Occupational Noise Exposure

8.1.1 Code of Federal Regulations, Subsection 1910.95

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ATTACHMENT 8.1

29 CFR 1910.95 OCCUPATIONAL NOISE EXPOSURE

Site:		Type of Audio Monitoring Equipment:		Date:
Employee Name	**Operation**	**Hearing Protection Type Attenuation Factor**	**Noise Levels Measured**	**Duration of Use**

Forward completed table (with backup noise monitoring data) to the Manager, Health Sciences.

FR 5322, Feb. 10, 1984; 55 FR 32015, Aug. 6, 1990; 58 FR 35308, June 30, 1993]

§ 1910.95 Occupational noise exposure.

(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table G-16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:

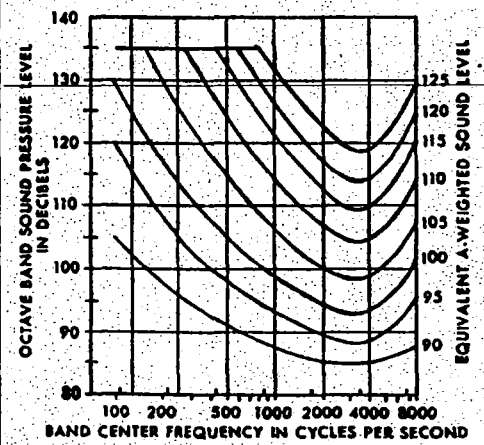


FIGURE G-9

Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on this graph and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table 1.G-16.

(b)(1) When employees are subjected to sound exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

(2) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

TABLE G-16—PERMISSIBLE NOISE EXPOSURES [1]

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

[1] When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: $C_1/T_1 + C_2/T_2 \ldots C_n/T_n$ exceeds unity, then, the mixed exposure should be considered to exceed the limit value. *Cn* indicates the total time of exposure at a specified noise level, and *Tn* indicates the total time of exposure permitted at that level.

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

(c) *Hearing conservation program.* (1) The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (o) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with appendix A and Table G-16a, and without regard to any attenuation provided by the use of personal protective equipment.

(2) For purposes of paragraphs (c) through (n) of this section, an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall also be referred to as the action level.

(d) *Monitoring.* (1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program.

(i) The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

(ii) Where circumstances such as high worker mobility, significant variations in sound level, or a significant

component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

(2)(i) All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.

(ii) Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

(3) Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

(i) Additional employees may be exposed at or above the action level; or

(ii) The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of paragraph (j) of this section.

(e) *Employee notification.* The employer shall notify each employee exposed at or above an 8-hour time-weighted average of 85 decibels of the results of the monitoring.

(f) *Observation of monitoring.* The employer shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted pursuant to this section.

(g) *Audiometric testing program.* (1) The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 decibels.

(2) The program shall be provided at no cost to employees.

(3) Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and checking calibration and proper functioning of the audiometers being used. A technician who operates microprocessor audiometers does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

(4) All audiograms obtained pursuant to this section shall meet the requirements of Appendix C: *Audiometric Measuring Instruments.*

(5) *Baseline audiogram.* (i) Within 6 months of an employee's first exposure at or above the action level, the employer shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

(ii) *Mobile test van exception.* Where mobile test vans are used to meet the audiometric testing obligation, the employer shall obtain a valid baseline audiogram within 1 year of an employee's first exposure at or above the action level. Where baseline audiograms are obtained more than 6 months after the employee's first exposure at or above the action level, employees shall wearing hearing protectors for any period exceeding six months after first exposure until the baseline audiogram is obtained.

(iii) Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. Hearing protectors may be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

(iv) The employer shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

(6) *Annual audiogram.* At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

(7) *Evaluation of audiogram.* (i) Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift as defined in paragraph (g)(10) of this section has oc-

curred. This comparison may be done by a technician.

(ii) If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

(iii) The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

(A) A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (n) of this section;

(B) The baseline audiogram and most recent audiogram of the employee to be evaluated;

(C) Measurements of background sound pressure levels in the audiometric test room as required in Appendix D: Audiometric Test Rooms.

(D) Records of audiometer calibrations required by paragraph (h)(5) of this section.

(8) *Follow-up procedures.* (i) If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined in paragraph (g)(10) of this section has occurred, the employee shall be informed of this fact in writing, within 21 days of the determination.

(ii) Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

(A) Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them.

(B) Employees already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

(C) The employee shall be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protectors.

(D) The employee is informed of the need for an otological examination if a medical pathology of the ear that is unrelated to the use of hearing protectors is suspected.

(iii) If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 90 decibels indicates that a standard threshold shift is not persistent, the employer:

(A) Shall inform the employee of the new audiometric interpretation; and

(B) May discontinue the required use of hearing protectors for that employee.

(9) *Revised baseline.* An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

(i) The standard threshold shift revealed by the audiogram is persistent; or

(ii) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

(10) *Standard threshold shift.* (i) As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

(ii) In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix F: *Calculation and Application of Age Correction to Audiograms.*

(h) *Audiometric test requirements.* (1) Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Tests at each frequency shall be taken separately for each ear.

(2) Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that

meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969.

(3) Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in Appendix C: *Audiometric Measuring Instruments.*

(4) Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix D: *Audiometric Test Rooms.*

(5) *Audiometer calibration.* (i) The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 decibels or greater require an acoustic calibration.

(ii) Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix E: *Acoustic Calibration of Audiometers.* Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 decibels or greater require an exhaustive calibration.

(iii) An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.3.; 4.1.4.3; 4.2; 4.4.1; 4.4.2; 4.4.3; and 4.5 of the American National Standard Specification for Audiometers, S3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

(i) *Hearing protectors.* (1) Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

(2) Employers shall ensure that hearing protectors are worn:

(i) By an employee who is required by paragraph (b)(1) of this section to wear personal protective equipment; and

(ii) By any employee who is exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

(A) Has not yet had a baseline audiogram established pursuant to paragraph (g)(5)(ii); or

(B) Has experienced a standard threshold shift.

(3) Employees shall be given the opportunity to select their hearing protectors from a variety of suitable hearing protectors provided by the employer.

(4) The employer shall provide training in the use and care of all hearing protectors provided to employees.

(5) The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

(j) *Hearing protector attenuation.* (1) The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the evaluation methods described in Appendix B: *Methods for Estimating the Adequacy of Hearing Protection Attenuation.*

(2) Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by paragraph (b) of this section.

(3) For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposure to an 8-hour time-weighted average of 85 decibels or below.

(4) The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employer shall provide more effective hearing protectors where necessary.

(k) *Training program.* (1) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

(2) The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work processes.

(3) The employer shall ensure that each employee is informed of the following:

(i) The effects of noise on hearing;

(ii) The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and

(iii) The purpose of audiometric testing, and an explanation of the test procedures.

(l) *Access to information and training materials.* (1) The employer shall make available to affected employees or their representatives copies of this standard and shall also post a copy in the workplace.

(2) The employer shall provide to affected employees any informational materials pertaining to the standard that are supplied to the employer by the Assistant Secretary.

(3) The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the Assistant Secretary and the Director.

(m) *Recordkeeping*—(1) *Exposure measurements.* The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

(2) *Audiometric tests.* (i) The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) of this section:

(ii) This record shall include:

(A) Name and job classification of the employee;

(B) Date of the audiogram;

(C) The examiner's name;

(D) Date of the last acoustic or exhaustive calibration of the audiometer; and

(E) Employee's most recent noise exposure assessment.

(F) The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.

(3) *Record retention.* The employer shall retain records required in this paragraph (m) for at least the following periods.

(i) Noise exposure measurement records shall be retained for two years.

(ii) Audiometric test records shall be retained for the duration of the affected employee's employment.

(4) *Access to records.* All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee, and the Assistant Secretary. The provisions of 29 CFR 1910.20 (a)–(e) and (g)–(i) apply to access to records under this section.

(5) *Transfer of records.* If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in paragraph (m) (3) of this section.

(n) *Appendices.* (1) Appendices A, B, C, D, and E to this section are incorporated as part of this section and the contents of these appendices are mandatory.

(2) Appendices F and G to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

(o) *Exemptions.* Paragraphs (c) through (n) of this section shall not apply to employers engaged in oil and gas well drilling and servicing operations.

(p) *Startup date.* Baseline audiograms required by paragraph (g) of this section shall be completed by March 1, 1984.

(Approved by the Office of Management and Budget under control number 1218-0048)

Appendix A to § 1910.95—Noise Exposure Computation

This Appendix is Mandatory

I. Computation of Employee Noise Exposure

(1) Noise dose is computed using Table G-16a as follows:

(i) When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by: D=100 C/T where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table G-16a or by the formula shown as a footnote to that table.

(ii) When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by:

$D=100\ (C_1/T_1+C_2/T_2+\ldots+C_n/T_n)$,

where C_n indicates the total time of exposure at a specific noise level, and T_n indicates the reference duration for that level as given by Table G-16a.

(2) The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula: $TWA=16.61\ \log_{10}\ (D/100)+90$. For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(3) A table relating dose and TWA is given in Section II.

TABLE G-16a

A-weighted sound level, L (decibel)	Reference duration, T (hour)
80	32
81	27.9
82	24.3
83	21.1
84	18.4
85	16
86	13.9
87	12.1
88	10.6
89	9.2
90	8
91	7.0
92	6.1
93	5.3
94	4.6
95	4
96	3.5
97	3.0
98	2.6
99	2.3
100	2
101	1.7
102	1.5
103	1.3
104	1.1
105	1
106	0.87
107	0.76
108	0.66
109	0.57
110	0.5
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.125
121	0.11
122	0.095
123	0.082

TABLE G-16a—Continued

A-weighted sound level, L (decibel)	Reference duration, T (hour)
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031

In the above table the reference duration, T, is computed by

$$T = \frac{8}{2^{(L-90)/5}}$$

where L is the measured A-weighted sound level.

II. Conversion Between "Dose" and "8-Hour Time-Weighted Average" Sound Level

Compliance with paragraphs (c)-(r) of this regulation is determined by the amount of exposure to noise in the workplace. The amount of such exposure is usually measured with an audiodosimeter which gives a readout in terms of "dose." In order to better understand the requirements of the amendment, dosimeter readings can be converted to an "8-hour time-weighted average sound level." (TWA).

In order to convert the reading of a dosimeter into TWA, see Table A-1, below. This table applies to dosimeters that are set by the manufacturer to calculate dose or percent exposure according to the relationships in Table G-16a. So, for example, a dose of 91 percent over an eight hour day results in a TWA of 89.3 dB, and, a dose of 50 percent corresponds to a TWA of 85 dB.

If the dose as read on the dosimeter is less than or greater than the values found in Table A-1, the TWA may be calculated by using the formula: $TWA=16.61\ \log_{10}\ (D/100)+90$ where TWA=8-hour time-weighted average sound level and D=accumulated dose in percent exposure.

TABLE A-1—CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)

Dose or percent noise exposure	TWA
10	73.4
15	76.3
20	78.4
25	80.0
30	81.3
35	82.4
40	83.4
45	84.2
50	85.0
55	85.7
60	86.3
65	86.9
70	87.4
75	87.9
80	88.4
81	88.5
82	88.6
83	88.7
84	88.7
85	88.8
86	88.9
87	89.0
88	89.1
89	89.2
90	89.2
91	89.3
92	89.4
93	89.5
94	89.6
95	89.6
96	89.7
97	89.8
98	89.9
99	89.9
100	90.0
101	90.1
102	90.1
103	90.2
104	90.3
105	90.4
106	90.4
107	90.5
108	90.6
109	90.6
110	90.7
111	90.8
112	90.8
113	90.9
114	90.9
115	91.1
116	91.1
117	91.1
118	91.2
119	91.3
120	91.3
125	91.6
130	91.9
135	92.2
140	92.4
145	92.7
150	92.9
155	93.2
160	93.4
165	93.6
170	93.8
175	94.0

TABLE A-1—CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)—Continued

Dose or percent noise exposure	TWA
180	94.2
185	94.4
190	94.6
195	94.8
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2
320	98.4
330	98.6
340	98.8
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8
520	101.9
530	102.0
540	102.2
550	102.3
560	102.4
570	102.6
580	102.7
590	102.8
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1

TABLE A-1—CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)—Continued

Dose or percent noise exposure	TWA
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
999	106.6

APPENDIX B TO § 1910.95—METHODS FOR ESTIMATING THE ADEQUACY OF HEARING PROTECTOR ATTENUATION

This Appendix is Mandatory

For employees who have experienced a significant threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protector attenuation.

The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.

Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods #1, #2 and #3. The NRR described below is a simplification of NIOSH method #2. The most complex method is NIOSH method #1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment.

NOTE: The employer must remember that calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

When using the NRR to assess hearing protector adequacy, one of the following methods must be used:

(i) When using a dosimeter that is capable of C-weighted measurements:

(A) Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see appendix A, II).

(B) Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(ii) When using a dosimeter that is not capable of C-weighted measurements, the following method may be used:

(A) Convert the A-weigh ed dose to TWA (see appendix A).

(B) Subtract 7 dB from the NRR.

(C) Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iii) When using a sound level meter set to the A-weighting network:

(A) Obtain the employee's A-weighted TWA.

(B) Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iv) When using a sound level meter set on the C-weighting network:

(A) Obtain a representative sample of the C-weighted sound levels in the employee's environment.

(B) Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

(v) When using area monitoring procedures and a sound level meter set to the A-weighing network.

(A) Obtain a representative sound level for the area in question.

(B) Subtract 7 dB from the NRR and subtract the remainder from the A-weighted sound level for that area.

(vi) When using area monitoring procedures and a sound level meter set to the C-weighting network:

(A) Obtain a representative sound level for the area in question.

(B) Subtract the NRR from the C-weighted sound level for that area.

Appendix C to § 1910.95—Audiometric Measuring Instruments

This Appendix is Mandatory

1. In the event that pulsed-tone audiometers are used, they shall have a tone on-time of at least 200 milliseconds.

2. Self-recording audiometers shall comply with the following requirements:

(A) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines shall be equally spaced and shall be separated by at least ¼ inch. Additional increments are optional. The audiogram pen tracings shall not exceed 2 dB in width.

(B) It shall be possible to set the stylus manually at the 10-dB increment lines for calibration purposes.

(C) The slewing rate for the audiometer attenuator shall not be more than 6 dB/sec except that an initial slewing rate greater than 6 dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response.

(D) The audiometer shall remain at each required test frequency for 30 seconds (± 3 seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than ± 3 seconds.

(E) It must be possible at each test frequency to place a horizontal line segment parallel to the time axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at that test frequency. At each test frequency the threshold shall be the average of the midpoints of the tracing excursions.

Appendix D to § 1910.95—Audiometric Test Rooms

This Appendix is Mandatory

Rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table D-1 when measured by equipment conforming at least to the Type 2 requirements of American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976), and to the Class II requirements of American National Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets, S1.11-1971 (R1976).

Table D-1—Maximum Allowable Octave-Band Sound Pressure Levels for Audiometric Test Rooms

Octave-band center frequency (Hz)	500	1000	2000	4000	8000
Sound pressure level (dB)	40	40	47	57	62

Appendix E to § 1910.95—Acoustic Calibration of Audiometers

This Appendix is Mandatory

Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this appendix. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set, and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment shall be sufficient to determine that the audiometer is within the tolerances permitted by American Standard Specification for Audiometers, S3.6-1969.

(1) Sound Pressure Output Check

A. Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.

B. Set the audiometer's hearing threshold level (HTL) dial to 70 dB.

C. Measure the sound pressure level of the tones at each test frequency from 500 Hz through 6000 Hz for each earphone.

D. At each frequency the readout on the sound level meter should correspond to the levels in Table E-1 or Table E-2, as appropriate, for the type of earphone, in the column entitled "sound level meter reading."

(2) Linearity Check

A. With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70 dB.

B. Measure the sound levels in the coupler at each 10-dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting.

C. For each 10-dB decrement on the audiometer the sound level meter should indicate a corresponding 10 dB decrease.

D. This measurement may be made electrically with a voltmeter connected to the earphone terminals.

(3) Tolerances

When any of the measured sound levels deviate from the levels in Table E-1 or Table E-2 by ± 3 dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibra-

tion is advised. An exhaustive calibration is required if the deviations are greater than 15 dB or greater at any test frequency.

TABLE E-1—REFERENCE THRESHOLD LEVELS FOR TELEPHONICS—TDH-39 EARPHONES

Frequency, Hz	Reference threshold level for TDH-39 earphones, dB	Sound level meter reading, dB
500	11.5	81.5
1000	7	77
2000	9	79
3000	10	80
4000	9.5	79.5
6000	15.5	85.5

TABLE E-2—REFERENCE THRESHOLD LEVELS FOR TELEPHONICS—TDH-49 EARPHONES

Frequency, Hz	Reference threshold level for TDH-49 earphones, dB	Sound level meter reading, dB
500	13.5	83.5
1000	7.5	77.5
2000	11	81.0
3000	9.5	79.5
4000	10.5	80.5
6000	13.5	83.5

APPENDIX F TO § 1910.95—CALCULATIONS AND APPLICATION OF AGE CORRECTIONS TO AUDIOGRAMS

This Appendix Is Non-Mandatory

In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging to the change in hearing level by adjusting the most recent audiogram. If the employer chooses to adjust the audiogram, the employer shall follow the procedure described below. This procedure and the age correction tables were developed by the National Institute for Occupational Safety and Health in the criteria document entitled "Criteria for a Recommended Standard . . . Occupational Exposure to Noise," ((HSM)-11001).

For each audiometric test frequency:

(i) Determine from Tables F-1 or F-2 the age correction values for the employee by:

(A) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz;

(B) Finding the age at which the baseline audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz.

(ii) Subtract the values found in step (i)(B) from the value found in step (i)(A).

(iii) The differences calculated in step (ii) represented that portion of the change in hearing that may be due to aging.

EXAMPLE: Employee is a 32-year-old male. The audiometric history for his right ear is shown in decibels below.

Employee's age	Audiometric test frequency (Hz)				
	1000	2000	3000	4000	6000
26	10	5	5	10	5
*27	0	0	0	5	5
28	0	0	0	10	5
29	5	0	5	15	5
30	0	5	10	20	10
31	5	10	20	15	15
*32	5	10	10	25	20

The audiogram at age 27 is considered the baseline since it shows the best hearing threshold levels. Asterisks have been used to identify the baseline and most recent audiogram. A threshold shift of 20 dB exists at 4000 Hz between the audiograms taken at ages 27 and 32.

(The threshold shift is computed by subtracting the hearing threshold at age 27, which was 5, from the hearing threshold at age 32, which is 25). A retest audiogram has confirmed this shift. The contribution of aging to this change in hearing may be estimated in the following manner:

Go to Table F-1 and find the age correction values (in dB) for 4000 Hz at age 27 and age 32.

	Frequency (Hz)				
	1000	2000	3000	4000	6000
Age 32	6	5	7	10	14
Age 27	5	4	6	7	11
Difference	1	1	1	3	3

The difference represents the amount of hearing loss that may be attributed to aging in the time period between the baseline audiogram and the most recent audiogram. In this example, the difference at 4000 Hz is 3 dB. This value is subtracted from the hearing level at 4000 Hz, which in the most recent audiogram is 25, yielding 22 after adjustment. Then the hearing threshold in the baseline audiogram at 4000 Hz (5) is subtracted from the adjusted annual audio-

gram hearing threshold at 4000 Hz (22). Thus the age-corrected threshold shift would be 17 dB (as opposed to a threshold shift of 20 dB without age correction).

TABLE F-1—AGE CORRECTION VALUES IN DECIBELS FOR MALES

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
20 or younger	5	3	4	5	8
21	5	3	4	5	8
22	5	3	4	5	8
23	5	3	4	6	9
24	5	3	5	6	9
25	5	3	5	7	10
26	5	4	5	7	10
27	5	4	6	7	11
28	6	4	6	8	11
29	6	4	6	8	12
30	6	4	6	9	12
31	6	4	7	9	13
32	6	5	7	10	14
33	6	5	7	10	14
34	6	5	8	11	15
35	7	5	8	11	15
36	7	5	9	12	16
37	7	6	9	12	17
38	7	6	9	13	17
39	7	6	10	14	18
40	7	6	10	14	19
41	7	6	10	14	20
42	8	7	11	16	20
43	8	7	12	16	21
44	8	7	12	17	22
45	8	7	13	18	23
46	8	8	13	19	24
47	8	8	14	19	24
48	9	8	14	20	25
49	9	9	15	21	26
50	9	9	16	22	27
51	9	9	16	23	28
52	9	10	17	24	29
53	9	10	18	25	30
54	10	10	18	26	31
55	10	11	19	27	32
56	10	11	20	28	34
57	10	11	21	29	35
58	10	12	22	31	36
59	11	12	22	32	37
60 or older	11	13	23	33	38

TABLE F-2—AGE CORRECTION VALUES IN DECIBELS FOR FEMALES

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
20 or younger	7	4	3	3	6
21	7	4	4	3	6
22	7	4	4	4	6
23	7	5	4	4	7
24	7	5	4	4	7
25	8	5	4	4	7
26	8	5	5	4	8
27	8	5	5	5	8
28	8	5	5	5	8
29	8	5	5	5	9

TABLE F-2—AGE CORRECTION VALUES IN DECIBELS FOR FEMALES—Continued

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
30	8	6	5	5	9
31	8	6	6	5	9
32	9	6	6	6	10
33	9	6	6	6	10
34	9	6	6	6	10
35	9	6	7	7	11
36	9	7	7	7	11
37	9	7	7	7	12
38	10	7	7	7	12
39	10	7	8	8	12
40	10	7	8	8	13
41	10	8	8	8	13
42	10	8	9	9	13
43	11	8	9	9	14
44	11	8	9	9	14
45	11	8	10	10	15
46	11	9	10	10	15
47	11	9	10	11	16
48	12	9	11	11	16
49	12	9	11	11	16
50	12	10	11	12	17
51	12	10	12	12	17
52	12	10	12	13	18
53	13	10	13	13	18
54	13	11	13	14	19
55	13	11	14	14	19
56	13	11	14	15	20
57	13	11	15	15	20
58	14	12	15	16	21
59	14	12	16	16	21
60 or older	14	12	16	17	22

APPENDIX G TO § 1910.95—MONITORING NOISE LEVELS NON-MANDATORY INFORMATIONAL APPENDIX

This appendix provides information to help employers comply with the noise monitoring obligations that are part of the hearing conservation amendment.

WHAT IS THE PURPOSE OF NOISE MONITORING?

This revised amendment requires that employees be placed in a hearing conservation program if they are exposed to average noise levels of 85 dB or greater during an 8 hour workday. In order to determine if exposures are at or above this level, it may be necessary to measure or monitor the actual noise levels in the workplace and to estimate the noise exposure or "dose" received by employees during the workday.

WHEN IS IT NECESSARY TO IMPLEMENT A NOISE MONITORING PROGRAM?

It is not necessary for every employer to measure workplace noise. Noise monitoring or measuring must be conducted only when exposures are at or above 85 dB. Factors which suggest that noise exposures in the workplace may be at this level include employee complaints about the loudness of noise, indications that employees are losing

their hearing, or noisy conditions which make normal conversation difficult. The employer should also consider any information available regarding noise emitted from specific machines. In addition, actual workplace noise measurements can suggest whether or not a monitoring program should be initiated.

HOW IS NOISE MEASURED?

Basically, there are two different instruments to measure noise exposures: the sound level meter and the dosimeter. A sound level meter is a device that measures the intensity of sound at a given moment. Since sound level meters provide a measure of sound intensity at only one point in time, it is generally necessary to take a number of measurements at different times during the day to estimate noise exposure over a workday. If noise levels fluctuate, the amount of time noise remains at each of the various measured levels must be determined.

To estimate employee noise exposures with a sound level meter it is also generally necessary to take several measurements at different locations within the workplace. After appropriate sound level meter readings are obtained, people sometimes draw "maps" of the sound levels within different areas of the workplace. By using a sound level "map" and information on employee locations throughout the day, estimates of individual exposure levels can be developed. This measurement method is generally referred to as *area* noise monitoring.

A dosimeter is like a sound level meter except that it stores sound level measurements and integrates these measurements over time, providing an average noise exposure reading for a given period of time, such as an 8-hour workday. With a dosimeter, a microphone is attached to the employee's clothing and the exposure measurement is simply read at the end of the desired time period. A reader may be used to read-out the dosimeter's measurements. Since the dosimeter is worn by the employee, it measures noise levels in those locations in which the employee travels. A sound level meter can also be positioned within the immediate vicinity of the exposed worker to obtain an individual exposure estimate. Such procedures are generally referred to as *personal* noise monitoring.

Area monitoring can be used to estimate noise exposure when the noise levels are relatively constant and employees are not mobile. In workplaces where employees move about in different areas or where the noise intensity tends to fluctuate over time, noise exposure is generally more accurately estimated by the personal monitoring approach.

In situations where personal monitoring is appropriate, proper positioning of the microphone is necessary to obtain accurate measurements. With a dosimeter, the microphone is generally located on the shoulder and remains in that position for the entire workday. With a sound level meter, the microphone is stationed near the employee's head, and the instrument is usually held by an individual who follows the employee as he or she moves about.

Manufacturer's instructions, contained in dosimeter and sound level meter operating manuals, should be followed for calibration and maintenance. To ensure accurate results, it is considered good professional practice to calibrate instruments before and after each use.

HOW OFTEN IS IT NECESSARY TO MONITOR NOISE LEVELS?

The amendment requires that when there are significant changes in machinery or production processes that may result in increased noise levels, remonitoring must be conducted to determine whether additional employees need to be included in the hearing conservation program. Many companies choose to remonitor periodically (once every year or two) to ensure that all exposed employees are included in their hearing conservation programs.

WHERE CAN EQUIPMENT AND TECHNICAL ADVICE BE OBTAINED?

Noise monitoring equipment may be either purchased or rented. Sound level meters cost about $500 to $1,000, while dosimeters range in price from about $750 to $1,500. Smaller companies may find it more economical to rent equipment rather than to purchase it. Names of equipment suppliers may be found in the telephone book (Yellow Pages) under headings such as: "Safety Equipment," "Industrial Hygiene," or "Engineers-Acoustical." In addition to providing information on obtaining noise monitoring equipment, many companies and individuals included under such listings can provide professional advice on how to conduct a valid noise monitoring program. Some audiological testing firms and industrial hygiene firms also provide noise monitoring services. Universities with audiology, industrial hygiene, or acoustical engineering departments may also provide information or may be able to help employers meet their obligations under this amendment.

Free, on-site assistance may be obtained from OSHA-supported state and private consultation organizations. These safety and health consultative entities generally give priority to the needs of small businesses. See the attached directory for a listing of organizations to contact for aid.

OSHA ONSITE CONSULTATION PROJECT DIRECTORY

State	Office and address	Contact
Alabama	Alabama Consultation Program, P.O. Box 6005, University, Alabama 35486.	(205) 348-7136, Mr. William Weems, Director.
Alaska	State of Alaska, Department of Labor, Occupational Safety & Health, 3301 Eagle St., Pouch 7-022, Anchorage, Alaska 99510.	(907) 276-5013, Mr. Stan Godsoe, Project Manager (Air Mail).
American Samoa	Service not yet available.	
Arizona	Consultation and Training, Arizona Division of Occupational Safety and Health, P.O. Box 19070, 1824 W. Adams, Phoenix, AZ 85005.	(602) 255-5795, Mr. Thomas Ramaley, Manager.
Arkansas	OSHA Consultation, Arkansas Department of Labor, 1022 High St., Little Rock, Ark. 72202.	(501) 371-2992, Mr. George Smith, Project Director.
California	CAL/OSHA Consultation Service, 2nd Floor, 525 Golden Gate Avenue, San Francisco, CA 94102.	(415) 557-2870, Mr. Emmett Jones, Chief.
Colorado	Occupational Safety & Health Section, Colorado State University, Institute of Rural Environmental Health, 110 Veterinary Science Building, Fort Collins, CO 80523.	(303) 491-6151, Dr. Roy M. Buchan, Project Director.
Connecticut	Division of Occupational Safety & Health, Connecticut Department of Labor, 200 Folly Brook Boulevard, Wethersfield, Conn. 06109.	(203) 566-4550, Mr. Leo Alix, Director.
Delaware	Delaware Department of Labor, Division of Industrial Affairs, 820 North French Street, 6th Floor, Wilmington, DE 19801.	(302) 571-3908, Mr. Bruno Salvadori, Director.
District of Columbia	Occupational Safety & Health Division, District of Columbia, Department Employment Services, Office of Labor Standards, 2900 Newton Street NE., Washington, DC 20018.	(202) 832-1230, Mr. Lorenzo M. White, Acting Associate Director.
Florida	Department of Labor & Employment Security, Bureau of Industrial Safety and Health, LaFayette Building, Room 204, 2551 Executive Center Circle West, Tallahassee, FL 32301.	(904) 488-3044, Mr. John C. Glenn, Administrator.
Georgia	Economic Development Division, Technology and Development Laboratory, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, GA 30332.	(404) 894-3806, Mr. William C. Howard, Assistant to Director. Mr. James Burson, Project Manager.
Guam	Department of Labor, Government of Guam, 23548 Guam Main Facility, Agana, Guam 96921.	(671) 772-6291, Joe R. San Agustin, Director.
Hawaii	Education and Information Branch, Division of Occupational Safety and Health, Suite 910, 677 Ala Moana, Honolulu, HI 96813.	(808) 548-2511, Mr. Don Alper, Manager (Air Mail).
Idaho	OSHA Onsite Consultation Program, Boise State University, Community and Environmental Health, 1910 University Drive, Boise, ID 83725.	(208) 385-3929, Dr. Eldon Edmundson, Director.
Illinois	Division of Industrial Services, Dept. of Commerce and Community Affairs, 310 S. Michigan Avenue, 10 Floor, Chicago, IL 60601.	(800) 972-4140/4216 (Toll-free in State), (312) 793-3270, Mr. Stan Czwinski, Assistant Director.
Iowa	Bureau of Labor, 307 E. Seventh Street, Des Moines, IA 50319.	(515) 281-3606, Mr. Allen J. Meier, Commissioner.
Indiana	Bureau of Safety, Education and Training, Indiana Division of Labor, 1013 State Office Building, Indianapolis, IN 46204.	(317) 633-5845, Mr. Harold Mills, Director.
Kansas	Kansas Dept. of Human Resources, 401 Topeka Ave., Topeka, KS 66603.	(913) 296-4086, Mr. Jerry Abbott, Secretary.
Kentucky	Education and Training, Occupational Safety and Health, Kentucky Department of Labor, 127 Building, 127 South, Frankfort, KY 40601.	(502) 564-6895, Mr. Larry Potter, Director.
Louisiana	No services available as yet (Pending FY 83).	
Maine	Division of Industrial Safety, Maine Dept. of Labor, Labor Station 45, State Office Building, Augusta, ME 04333.	(207) 289-3331, Mr. Lester Wood, Director.
Maryland	Consultation Services, Division of Labor & Industry, 501 St. Paul Place, Baltimore, Maryland 21202.	(301) 659-4210, Ms. Ileana O'Brien, Project Manager, 7(c)(1) Agreement.
Massachusetts	Division of Industrial Safety, Massachusetts Department of Labor and Industries, 100 Cambridge Street, Boston, MA 02202.	(617) 727-3567, Mr. Edward Noseworthy, Project Director.

OSHA ONSITE CONSULTATION PROJECT DIRECTORY—Continued

State	Office and address	Contact
Michigan (Health)	Special Programs Section, Division of Occupational Health, Michigan Dept. of Public Health, 3500 N. Logan, Lansing, MI 48909.	(517) 373-1410, Mr. Irving Davis, Chief.
Michigan (Safety)	Safety Education & Training Division Bureau of Safety and Regulation, Michigan Department of Labor, 7150 Harris Drive, Box 30015, Lansing, Michigan 48909.	(517) 322-1809, Mr. Alan Harvie, Chief.
Minnesota	Training and Education Unit, Department of Labor and Industry, 5th Floor, 444 Lafayette Road, St. Paul, MN 55101.	(612) 296-2973, Mr. Timothy Tierney, Project Manager.
Mississippi	Division of Occupational Safety and Health, Mississippi State Board of Health, P.O. Box 1700, Jackson, MS 39205.	(601) 982-6315, Mr. Henry L. Laird, Director.
Missouri	Missouri Department of Labor and Industrial Relations, 722 Jefferson Street, Jefferson City, MO 65101.	1-(800) 392-0208, (314) 751-3403, Ms. Paula Smith, Mr. Jim Brake.
Montana	Montana Bureau of Safety & Health, Division of Workers Compensation, 815 Front Street, Helena, MT 59601.	(406) 449-3402, Mr. Ed Gatzemeier, Chief.
Nebraska	Nebraska Department of Labor, State House Station, State Capitol, P.O. Box 94600, Lincoln, NB 68509.	475-8451 Ext. 258, Mr. Joseph Carroll, Commissioner.
Nevada	Department of Occupational Safety and Health, Nevada Industrial Commission, 515 E. Musser Street, Carson City, NV 89714.	(702) 885-5240, Mr. Allen Traenkner, Director.
New Hampshire	For information contact	Office of Consultation Programs, Room N3472 200 Constitution Avenue, NW. Washington, DC 20210, Phone: (202) 523-8985.
New Jersey	New Jersey Department of Labor and Industry Division of Work Place Standards, CN-054, Trenton, NJ 08625.	(609) 292-2313, FTS-8-477-2313, Mr. William Clark, Assistant Commissioner.
New Mexico	OSHA Consultation, Health and Environment Department, Environmental Improvement Division, Occupational Health & Safety Section, 4215 Montgomery Boulevard, NE., Albuquerque, NM 87109.	(505) 842-3387, Mr. Albert M. Stevens, Project Manager.
New York	Division of Safety and Health, New York State Department of Labor, 2 World Trade Center, Room 6995, New York, NY 10047.	(212) 488-7746/7, Mr. Joseph Alleva, Project Manager, DOSH.
North Carolina	Consultation Services, North Carolina Department of Labor, 4 West Edenton Street, Raleigh, NC 27601.	(919) 733-4885, Mr. David Pierce, Director.
North Dakota	Division of Environmental Research, Department of Health, Missouri Office Building, 1200 Missouri Avenue, Bismarck, ND 58505.	(701) 224-2348, Mr. Jay Crawford, Director.
Ohio	Department of Industrial Relations, Division of Onsite Consultation, P.O. Box 825, 2323 5th Avenue, Columbus, OH 43216.	(800) 282-1425 (Toll-free in State), (614) 466-7485, Mr. Andrew Doehrel, Project Manager.
Oklahoma	OSHA Division, Oklahoma Department of Labor, State Capitol, Suite 118, Oklahoma City, OK 73105.	(405) 521-2461, Mr. Charles W. McGlon, Director.
Oregon	Consultative Section, Department of Workers' Compensation, Accident Prevention Division, Room 102, Building 1, 2110 Front Street NE., Salem, OR 97310.	(503) 378-2690, Mr. Jack Buckland, Supervisor.
Pennsylvania	For information contact	Office of Consultation Programs, Room N3472, 200 Constitution Avenue NW., Washington, DC 20210, Phone: (202) 523-8985.
Puerto Rico	Occupational Safety & Health, Puerto Rico Department of Labor and Human Resources, 505 Munoz Rivera Ave., 21st Floor, Hato Rey, Puerto Rico 00919.	(809) 754-2134, Mr. John Cinque, Assistant Secretary. (Air Mail).
Rhode Island	Division of Occupational Health, Rhode Island Department of Health, The Cannon Building, 206 Health Department Building, Providence, RI 02903.	(401) 277-2438, Mr. James E. Hickey, Chief.

OSHA ONSITE CONSULTATION PROJECT DIRECTORY—Continued

State	Office and address	Contact
South Carolina	Consultation and Monitoring, South Carolina Department of Labor, P.O. Box 11329, Columbia, SC 29211.	(803) 758-8921, Mr. Robert Peck, Director, 7(c)(1), Project.
South Dakota	South Dakota Consultation Program, South Dakota State University, S.T.A.T.E.-Engineering Extension, 201 Pugsley Center-SDSO, Brookings, SD 57007.	(605) 688-4101, Mr. James Ceglian, Director.
Tennessee	OSHA Consultative Services, Tennessee Department of Labor, 2nd Floor, 501 Union Building, Nashville, TN 37219.	(615) 741-2793, Mr. L. H. Craig Director.
Texas	Division of Occupational Safety and State Safety Engineer, Texas Department of Health and Resources, 1100 West 49th Street, Austin, TX 78756.	(512) 458-7257, Mr. Walter G. Martin, P.E. Director.
Trust Territories	Service not yet available.	
Utah	Utah Job Safety and Health Consultation Service, Suite 4004, Crane Building, 307 West 200 South, Salt Lake City, UT 84101.	(801) 533-7927/8/9, Mr. H. M. Bergeson, Project Director.
Vermont	Division of Occupational Safety and Health, Vermont Department of Labor and Industry, 118 State Street, Montpelier, VT 05602.	(802) 828-2765, Mr. Robert Mcleod, Project Director.
Virginia	Department of Labor and Industry, P.O. Box 12064, 205 N. 4th Street, Richmond, Va. 23241.	(804) 786-5875, Mr. Robert Beard, Commissioner.
Virgin Islands	Division of Occupational Safety and Health, Virgin Islands Department of Labor, Lagoon Street, Room 207, Frederiksted, Virgin Islands 00840.	(809) 772-1315, Mr. Louis Llanos, Deputy Director-DOSH.
Washington	Department of Labor and Industry, P.O. Box 207, Olympia, WA 98504.	(206) 753-6500, Mr. James Sullivan, Assistant Director.
West Virginia	West Virginia Department of Labor, Room 451B, State Capitol, 1900 Washington Street, Charleston, WV 25305.	FTS 8-885-7890, Mr. Lawrence Barker, Commissioner.
Wisconsin (Health)	Section of Occupational Health, Department of Health and Social Services, P.O. Box 309, Madison, WI 53701.	(608) 266-0417, Ms. Patricia Natzke, Acting Chief.
Wisconsin (Safety)	Division of Safety and Buildings, Department of Industry, Labor and Human Relations, 1570 E. Moreland Blvd., Waukesha, WI 53186.	(414) 544-8686, Mr. Richard Michalski, Supervisor.
Wyoming	Wyoming Occupational Health and Safety Department, 200 East 8th Avenue, Cheyenne, Wyo. 82002.	(307) 777-7786, Mr. Donald Owsley, Health and Safety Administrator.

APPENDIX H TO § 1910.95—AVAILABILITY OF REFERENCED DOCUMENTS

Paragraphs (c) through (o) of 29 CFR 1910.95 and the accompanying appendices contain provisions which incorporate publications by reference. Generally, the publications provide criteria for instruments to be used in monitoring and audiometric testing. These criteria are intended to be mandatory when so indicated in the applicable paragraphs of § 1910.95 and appendices.

It should be noted that OSHA does not require that employers purchase a copy of the referenced publications. Employers, however, may desire to obtain a copy of the referenced publications for their own information.

The designation of the paragraph of the standard in which the referenced publications appear, the titles of the publications, and the availability of the publications are as follows:

Paragraph designation	Referenced publication	Available from—
Appendix B	"List of Personal Hearing Protectors and Attenuation Data," HEW Pub. No. 76-120, 1975. NTIS-PB267461.	National Technical Information Service, Port Royal Road, Springfield, VA 22161.
Appendix D	"Specification for Sound Level Meters," S1.4-1971 (R1976).	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
§ 1910.95(i)(2), appendix E	"Specifications for Audiometers," S3.6-1969.	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

ATTACHMENT VI

SAFE WORK PERMITS

SAFE WORK PERMIT
DECONTAMINATION ACTIVITIES
NAVAL STATION GREAT LAKES, GREAT LAKES, ILLINOIS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. **Work limited to the following (description, area, equipment used):** Decontamination of heavy equipment and machinery (i.e., Drill and DPT rigs and accessories) will occur using pressure washers and/or steam cleaning units. Sampling equipment will be decontaminated using buckets, brushes and spray bottles at the work site or designated location.

II. **Primary Hazards:** Potential hazards associated with this task include lifting (strain/muscle pulls lifting heavy drilling equipment); Flying projectiles propelled by the force of the pressure washer/stream cleaner; noise;; Burns/water lacerations; Stacked equipment - falling hazards; slips, trips, and falls – slippery surfaces.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ TtNUS
Equipment Inspection required ☒ Yes ☐ No Initials of Inspector _____ TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: None anticipated

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
Liquinox (soap)	None Required	None	Eye irritant/flush with clean water

Primary Route of Exposure/Hazard: Soap – Contact - Eye irritant; ingestion - nausea possible vomiting, diarrhea; Exposure to residual site contaminants during this activity is considered negligible.

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes or No)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☒	☐	Hearing Protection (Plugs/Muffs)	☒	☐
Safety Glasses	☒	☐	Safety belt/harness	☐	☒
Chemical/splash goggles	☐	☒	Radio/Cellular Phone	☐	☒
Splash Shield	☒	☐	Barricades	☒	☐
Splash suits/coveralls	☐	☐	Gloves (Type – Nitrile)	☒	☐
Impermeable apron	☐	☐	Work/rest regimen	☐	☒
Steel toe Work shoes or boots	☒	☐	Chemical Resistant Boot Covers.	☒	☐
High Visibility vest	☐	☒	Tape up/use insect repellent	☐	☒
First Aid Kit	☒	☐	Fire Extinguisher	☒	☐
Safety Shower/Eyewash	☐	☐	Other	☐	☐

(All: Yes / No)

Modifications/Exceptions: If contact with overspray is likely, Impermeable aprons may be used at SSO's discretion. Another option is to use rainsuit or PE coated Tyvek. Hard hat, splash shield, hearing protection will be worn for pressure washer/steam cleaner operation. Gloves – Nitrile (surgeons style) or outer for cleaning hand tools, nitrile supported for steam cleaner/pressure washer operation.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for this task. Use drying racks to secure heavy equipment to prevent items from falling during washing and drying. In addition, avoid pointing the wand at other people or place it against any part of your body. Accidental compression of the trigger can cause water lacerations or burns. All hoses and fittings will be inspected to insure structural integrity prior to use. For pressure washers or steam cleaners in excess of 3,000 psi, a fan tip of 25° or greater will be used to control potential for water cuts or lacerations. A light coating of sand should be applied to the plastic liner should the surface becomes to slippery to prevent slips. Keep hoses gathered to prevent trips and falls. A site control boundary for this activity is 35-feet surrounding the point of operation. Follow MSDS for any decontamination solutions/solvents used.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
MOBILIZATION/DEMOBILIZATION ACTIVITIES
NAVAL STATION GREAT LAKES, GREAT LAKES, ILLINOIS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. **Work limited to the following (description, area, equipment used):** Mobilization and demobilization activities. These activities include site reconnaissance/site characterization, site preparation including the layout of sampling locations, securing the necessary utility clearances, and identifying/isolating physical hazards; Secure, construct, or equip decontamination and IDW storage facilities.

II. **Primary Hazards:** Potential hazards associated with this task are primarily physical in nature including lifting, cuts and lacerations, pinches and compressions; flying projectiles; slips, trips, and falls; insect and animal bites.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____ TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ See Reverse
No ☒

Modifications/Exceptions: None anticipated

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
None anticipated	NA	NA	NA

Primary Route of Exposure/Hazard: None

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes or No)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes ☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes ☐ No
Safety Glasses	☐ Yes ☐ No	Safety belt/harness	☐ Yes ☒ No
Chemical/splash goggles	☐ Yes ☒ No	Radio/Cellular Phone	☐ Yes ☐ No
Splash Shield	☐ Yes ☒ No	Barricades	☐ Yes ☐ No
Splash suits/coveralls	☐ Yes ☒ No	Gloves (Type – Leather/Cotton)	☐ Yes ☐ No
Impermeable apron	☐ Yes ☒ No	Work/rest regimen	☐ Yes ☒ No
Steel toe Work shoes or boots	☒ Yes ☐ No	Chemical Resistant Boot Covers	☐ Yes ☒ No
High Visibility vest	☐ Yes ☐ No	Tape up/use insect repellent	☐ Yes ☐ No
First Aid Kit	☒ Yes ☐ No	Fire Extinguisher	☐ Yes ☐ No
Safety Shower/Eyewash	☐ Yes ☐ No	Other	☐ Yes ☐ No

Modifications/Exceptions: If there are Flying projectiles– Safety glasses and/or splash shield (i.e., hammering, power tool operation); If you have to raise your voice to be heard by someone within 2-feet of you hearing protection is required (i.e., equipment/power tool operation); If overhead hazards or bump hazards or you are working near operating equipment hard hats will be employed. If you are working in or near traffic patterns then wear High Visibility Vests. Use insect repellant and tape up to protect against insects and insect bites. Wear snake chaps in high brush areas.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for this task. Caution should be exercised if working along the water. The potential for natural hazards including snakes, alligators may exist given the region.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
MULTI-MEDIA SAMPLING ACTIVITIES
NAVAL STATION GREAT LAKES, GREAT LAKES, ILLINOIS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. **Work limited to the following (description, area, equipment used):** Multi-media sampling

II. **Primary Hazards:** Potential hazards associated with this task include lifting, pinches and compressions opening MacroCore Samplers (Split spoons, stainless steel or brass) and handling containers; contact with contaminated media; burns from hot sampler and soil during and after treatability study.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Inspector Initials _____ TtNUS _____
Equipment Inspection required ☐ Yes ☐ No Inspector Initials _____ TtNUS _____

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ See Reverse
No ☒

Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
1,1 Dichloroethane,1,2 Dichloroethene, Tetrachloroethylene, and Trichloroethene	PID w/ 11.7 or FID	>10 PPM in BZ	Retreat upwind until levels return to background

Primary Route of Exposure/Hazard: Inhalation, ingestion, skin and eye contact. Inhalation exposure concerns are not likely to be encountered. Wear PPE, follow good personal hygiene and decontamination practices, and good site work practices (e.g., no hand-to-mouth actions on site, etc.) to control ingestion and skin and eye contact routes of entry.

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes or No)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – heavy duty cotton,)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☒ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Hard hat, hearing protection, and safety glasses for sampling at the DPT/air rotary rig; High Visibility Vests for high traffic areas; Tape up and use insect repellent; Spiders and bees prefer well protective casings as nesting areas; Open wells and allow to vent/off gas 3-5 minutes while preparing your equipment from an upwind position. Wear snake chaps in high brush areas. Tyveks and boot covers at SSO's discretion.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☐
Emergency Equipment Staged	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. **Special instructions, precautions:** Personal sampling at remote locations will bag contaminated PPE and reusable sampling tools. Use hygienic wipes for hands and face until persons can reach the structured decontamination unit. Minimize contact with potentially contaminated media. Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for mobilization/demobilization. For remote locations pack glass ware in hard sided containers to prevent falls breakage of glassware and possible lacerations. Provisions for protection against the sun should be provided to site personnel including shade providing devices requirements for hats, sun block, wrap around sun glasses.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
MONITORING WELL INSTALLATION/SOIL BORING
NAVAL STATION GREAT LAKES, GREAT LAKES, ILLINOIS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. **Work limited to the following (description, area, equipment used):** Soil boring will be accomplished using hollow stem auger methods or direct push technology DPT.

II. **Primary Hazards:** Potential hazards associated with this task include injury due to improper lifting and carrying, cuts and lacerations (cutting bags, well riser, etc.), cuts, pinches and compressions; burns handling split spoons; entanglement in rotating equipment; exposure to high pressure hydraulic and air lines; and contact with contaminated media.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Inspector Initials _____ TtNUS
Equipment Inspection required ☒ Yes ☐ No Inspector Initials _____ TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐
Modifications/Exceptions: _____

Respiratory equipment required
Yes ☐ See Reverse
No ☒

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
1,1 Dichloroethane,1,2 Dichloroethene, Tetrachloroethylene, and Trichloroethene	PID w/ 11.7 or FID	>10 PPM in BZ	Retreat upwind until levels return to background

Primary Route of Exposure/Hazard: Inhalation, ingestion, skin contact. Wear PPE, follow good personal hygiene and decontamination practices, and good site work practices (e.g., no hand-to-mouth actions on site, etc.) to control ingestion and skin contact routes of entry. To control dust emissions during operations insure the rig is equipped with a hood and swab and extension hose to remove dust emissions from the work area.

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes or No)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☒ Yes ☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes ☐ No
Safety Glasses	☒ Yes ☐ No	Safety belt/harness	☐ Yes ☒ No
Chemical/splash goggles	☐ Yes ☒ No	Radio/Cellular Phone	☐ Yes ☐ No
Splash Shield	☐ Yes ☒ No	Barricades	☒ Yes ☐ No
Splash suits/coveralls	☐ Yes ☐ No	Gloves (Type – heavy duty cotton)	☒ Yes ☐ No
Impermeable apron	☐ Yes ☐ No	Work/rest regimen	☐ Yes ☒ No
Steel toe Work shoes or boots	☒ Yes ☐ No	Chemical Resistant Boot Covers	☐ Yes ☐ No
High Visibility vest	☐ Yes ☐ No	Tape up/use insect repellent	☒ Yes ☐ No
First Aid Kit	☒ Yes ☐ No	Fire Extinguisher	☒ Yes ☐ No
Safety Shower/Eyewash	☒ Yes ☐ No	Other	☐ Yes ☐ No

Modifications/Exceptions: High Visibility Vests for high traffic areas; Tape up and use insect repellent to combat insect bites in forested or areas of heavy vegetation; Fire extinguisher for all vehicles in excess of 1-ton; Heat resistant cotton gloves for handling auger flights due to heat from ERH Treatment.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☐
Emergency Equipment Staged	☐	☐	☐

IX. **Additional Permits required** (Utility Locating and Excavation Clearance – Attachment V).. ☒ Yes ☐ No
If yes, SSO complete permit or contact Health Sciences, Pittsburgh Office (412) 921-7090

X. **Special instructions, precautions:** Follow the safe work practices for drilling specified in Section 5.2 of this HASP. Use proper lifting techniques defined in Table 5-1. Test all emergency stop devices initially then periodically to ensure operational status. Identify a person on the field crew as the Emergency Stop Operator. Visually insure all persons are removed from rotating apparatus. Verbally alert all persons as to the activation of the drill rig. Remove jewelry, loose clothing and other entanglement hazards. Personnel decontamination will consist of disposing of single use PPE and washing hands and face prior to breaks or meals. The potential for exposure can occur only through mechanical dispersion (inhalation) or hand to mouth contact (ingestion) through poor work hygiene practices. Utility clearance will proceed all subsurface installation. Locking clips or cable retention links will be used at all airline input connections.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
TOPOGRAPHIC SURVEYING
NAVAL STATION GREAT LAKES, GREAT LAKES, ILLINOIS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. **Work limited to the following (description, area, equipment used):** Topographic surveying and associated activities such as site reconnaissance and site preparation including the layout of control station and shooting vertical and horizontal control lines and fixed features such as intersections

II. **Primary Hazards:** Potential hazards associated with this task are primarily physical in nature including lifting, cuts and lacerations, pinches and compressions; flying projectiles; slips, trips, and falls; insect and animal bites

IV. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ TtNUS

Equipment Inspection required ☐ Yes ☒ No Initials of Inspector _____ TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. **Protective equipment required**

Level D ☒ Level B ☐

Level C ☐ Level A ☐

Respiratory equipment required

Yes ☐

No ☒

See Reverse

Modifications/Exceptions: None anticipated

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
None anticipated	NA	NA	NA

Primary Route of Exposure/Hazard: None

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes or No)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes ☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes ☒ No
Safety Glasses	☒ Yes ☐ No	Safety belt/harness	☐ Yes ☒ No
Chemical/splash goggles	☐ Yes ☒ No	Radio/Cellular Phone	☐ Yes ☐ No
Splash Shield	☐ Yes ☒ No	Barricades	☐ Yes ☒ No
Splash suits/coveralls	☐ Yes ☒ No	Gloves (Type – Leather/Cotton)	☐ Yes ☐ No
Impermeable apron	☐ Yes ☒ No	Work/rest regimen	☐ Yes ☒ No
Steel toe Work shoes or boots	☒ Yes ☐ No	Chemical Resistant Boot Covers	☐ Yes ☐ No
High Visibility vest	☐ Yes ☐ No	Tape up/use insect repellent	☒ Yes ☐ No
First Aid Kit	☒ Yes ☐ No	Fire Extinguisher	☐ Yes ☐ No
Safety Shower/Eyewash	☐ Yes ☒ No	Other	☐ Yes ☐ No

Modifications/Exceptions: Pant legs are to be taped to work boots to prevent entry under the clothing by ticks and other insects when working in heavy brush and wooded areas. Use insect repellants according to manufacturers recommendations. Tyvek coveralls may be used in heavy brush to protect against natural hazards (e.g., ticks) and also to make identification easier. If working in areas where snakes may be a threat, wear snake chaps. Surveyors working along highways and traffic pathways shall wear high visibility vests to increase visual recognition. Safety glasses and Hard Hats should be worn when cutting sight lines; leather or cotton work gloves when cutting brush.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No

If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for this task. Employ sharp tools for cutting brush, when not in use keep the sheath on the blade.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
IDW MANAGEMENT ACTIVITIES
NAVAL STATION GREAT LAKES, GREAT LAKES, ILLINOIS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. **Work limited to the following (description, area, equipment used):** IDW management activities includes containerization, staging, monitoring for leaks of IDW accumulated wastes. Wastes types include soil cutting, purge and decontamination wash waters.

II. **Primary Hazards:** Potential hazards associated with this task are primarily physical in nature including lifting, pinches and compressions; flying projectiles; slips, trips, and falls.

V. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ TtNUS
Equipment Inspection required ☐ Yes ☒ No Initials of Inspector _____ TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ See Reverse
No ☒

Modifications/Exceptions: None anticipated

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
None anticipated	NA	NA	NA

Primary Route of Exposure/Hazard: None

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes or No)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐	☐	Hearing Protection (Plugs/Muffs)	☐	☒
Safety Glasses	☐	☐	Safety belt/harness	☐	☒
Chemical/splash goggles	☐	☐	Radio/Cellular Phone	☐	☐
Splash Shield	☐	☒	Barricades	☐	☐
Splash suits/coveralls	☐	☒	Gloves (Type – Leather/Cotton)	☒	☐
Impermeable apron	☐	☒	Work/rest regimen	☐	☒
Steel toe Work shoes or boots	☒	☐	Chemical Resistant Boot Covers	☐	☒
High Visibility vest	☐	☒	Tape up/use insect repellent	☐	☐
First Aid Kit	☒	☐	Fire Extinguisher	☐	☐
Safety Shower/Eyewash	☐	☒	Other	☐	☐

(Yes / No)

Modifications/Exceptions: If you are using pneumatic/electric power to open drums – Safety glasses are required; If power equipment is employed to move drums or you are working near operating equipment hard hats will be employed.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1. When/where possible use heavy equipment to move and place containers. When placing drums – Place the label and retention ring nut on the outside where it is readily visible. Place 4-drums to a pallet. Maintain a minimum distance of 4-feet between pallet rows. An IDW inventory shall be generated to provide the number of drums, contents, and volumes. This inventory should be provided to the facility contact

Permit Issued by: _____ Permit Accepted by: _____

ATTACHMENT VII

THERMAL REMEDIATION SERVICE'S HEALTH AND SAFETY PLAN ADDENDUM ELECTRICAL RESISTANCE HEATING TREATMENT

Health & Safety Plan Addendum
Electrical Resistance Heating

Site 22
Naval Station
Great Lakes, Illinois

Date Issued—April 7, 2006

Prepared By
Thermal Remediation Services, Inc.
2325 Hudson Street
Longview, Washington 98362

Table of Contents

1.0 Introduction

This Site Health and Safety Plan (HASP) has been developed specifically for the Electrical Resistance heating (ERH) field activities at Site 22 (Former Dry Cleaning facility) located at Former Building 105, Naval Station Great Lakes Illinois. The focus of this project is to primarily remediate tetrachloroethene (PCE), trichloroethene (TCE), and 1,2-dichloroethene (DCE) in soil using ERH. Concentrations of vinyl chloride (VC) may be present and will also be remediated during the ERH process.

This HASP is considered a viable document that can be reevaluated in light of actual work progression and will be updated as needed. A copy of the HASP will be made available to all personnel involved with site activities for this project. It is the responsibility of the Site Safety and Health Officer (SSHO) to assure compliance with this HASP.

Thermal Remediation Services (TRS) and its subcontractors place a premium on safety and acknowledge that a safe and healthy workplace is the responsibility of each person involved with the project. TRS, to date, has had no accidents causing personal injury or loss of work. Activities associated with this project involve the installation of an electrode array and vapor extraction system; the installation of a Power Control Unit (PCU) and ERH process/treatment system which includes conveyance piping, a condenser, granular activated carbon (GAC) and a vapor recovery blower.

This HASP Addendum was prepared by TRS to incorporate the specific hazards of the ERH technology application into the Site HASP provided by Tetra Tech NUS, Inc. (TtNUS). Applicable health and safety concerns not addressed in this Health and Safety Plan Addendum will fall under the TtNUS Site Health and Safety Plan.

2.0 Site Personnel

The list below details the onsite personnel for TRS:

Personnel	Title	Task	Phone	Email
Jerry Wolf	VP Operations	Division supervision	(817) 379-0536	jwolf@thermalrs.com
Chris Blundy	Project Manager	Project supervision	(843) 225-6018	cblundy@thermalrs.com
Chad Crownover	Design Engineer	System design and as-built completion	(206) 934-1661	ccrownover@thermalrs.com
Miles Stumbaugh	Construction Manager	Construction supervision	(828) 994-0035	mstumbaugh@thermalrs.com
Brad Pierce	H&S Officer	Onsite H&S, construction, and operation	(480) 097-5427	bpierce@thermalrs.com
Paul Lansing	Assistant PM	Construction and operation	(314) 776-2832	plansing@thermalrs.com

3.0 Hazard Analysis

The following is a list of generic tasks required for the construction and operation of an ERH system as well as the potential hazards associated with such tasks.

3.1 Site Tasks and Operations

The following is a list of anticipated major site tasks and operations to be performed:

- Mobilize and demobilize equipment and temporary structures,
- Install electrodes/vapor recovery wells,
- Construct a vapor conveyance piping system
- Operate, monitor, and sample the ERH systems,
- Treat steam, soil vapors and extracted liquids
- Treat or dispose of collected contaminant streams.

3.1.1 Personal Protective Equipment

In order to provide adequate protection during ERH activities, personnel will wear Level D Personal Protective Equipment (PPE) when on site. Though not anticipated, in cases of contact with unknown chemical exposure scenarios, the level of PPE may be increased to level C or B based on chemical type and/or concentrations. Each level of PPE provides an additional level of protection from chemicals that may be encountered during the field work.

Level D PPE (anticipated for field operations) will include the following:

- Steel-toed work boots or safety boots/shoes with chemical resistant soles. Disposable boot covers are optional.
- Safety glasses or goggles (when required or appropriate).
- Hard hat (when required or appropriate).
- Work gloves (as needed).
- Hearing protection (ear plugs or ear muffs) when noise conditions are above 85 decibels (dBA) or as needed.

3.1.2 Mobilization and Demobilization of Equipment

The ERH system utilizes several pieces of equipment that require a forklift or crane to be unloaded from their delivery trailer. A list of the major items with its approximate weight is provided below:

- Power Control Unit (16,000 lbs)
- Condenser Unit (10,000 lbs)
- Cooling Tower (5,000 lbs)
- VR Blower (4,000 lbs)
- Electrode casings (2,000 lbs)
- Electrode backfill (2,500 lbs pallets)

These items will be mobilized with appropriately sized lifting mechanisms such as a forklift or crane. Before any lifting is performed a safety meeting will be conducted with all onsite personnel to establish a tailgate lift plan so that suspended items are picked and placed in safe short time frame. The lift plan will establish what item is being lifted, where it will be placed, who will lift the item and who will spot for the placement of the item. The tailgate lift plan will also review standard lifting hazards to reinforce common sense decisions by personnel that reduce slips, trips and falls; and pinch points; and establish communication between personnel.

3.1.3 Installation of Electrodes and Temperature Monitoring Points

The hazards associated with the installation of electrodes and temperature monitoring points (TMPs) are the same as groundwater monitoring well installation or soil sampling. The electrodes are constructed of steel pipe and should only be moved by a forklift or multiple personnel as the casings may weight as much as 150 lbs. The conductive backfill used to surround the electrode casings is very similar to the filter pack used in groundwater monitoring wells. The backfill is supplied in 50 lbs bags for easy application and has no dust related health issues. .The TMP casings are constructed of CPVC pipe and are very light weight compared to the electrode casings. The TMP casings can be as long as 28-feet and care should always be taken to ensure personnel will not be struck by the end of a pipe during staging and/or installation.

3.1.4 Vapor Recovery Piping Construction

The primary hazards associated with the construction of the vapor recovery piping system are medium weight lifting, cutting, and moving pipe. Small diameter pipe sections are light weight and can be moved by one person however care should always be taken to communicate with other workers so that the pipe does not physically impact others. Small diameter pipe (1-2-inch) will be cut be a pipe cutter to reduce the use of a reciprocating saw which will be used to cut larger pipe (2-4-inch). Gloves will be used during both forms of cutting and extra personnel will be used to secure larger pieces so they do not shift during cutting.

3.1.5 Primary Electrical Service Installation

The ERH system's primary electrical service will be brought to the area by a licensed electrical contractor via below grade conduit from an electrical switch located approximately 200 feet to the south of the equipment compound. The path of the directionally bored conduit will be cleared for utilities prior to any subsurface work and will not pass through any contaminated soil. All work on the primary electrical service installation will be performed on a non-energized system with energy only applied after all work has been completed and tested.

3.2 Hazards

Potential safety hazards may be encountered during site work. The specific hazards associated with the operation and maintenance of an ERH system are presented in the following pages. For additional information concerning potential hazards not specific to ERH at the site, please refer to the Site HASP prepared by TtNUS.

3.2.1 Electrical Voltage

Dangerous voltages can be present in the ERH field during heating operations. Startup and initial unattended operations of the ERH power control unit are performed only after the completion of an internal safety preparedness check. This internal check is called the Site Start-Up Checklist and shall be completed and signed off by TRS management prior to unattended operations. The Site Start-Up Checklist is included in the Project ERH Work Plan as attachment B.

To assist in the implementation of the TRS Electrical Safety Policy, the following ERH specific application procedures have been developed:

- ERH system designs will identify engineering controls to minimize the possibility of voltage hazards. These design components will be included in ERH system construction and will be documented, as necessary, in Work Plans, drawings, and other project documents.
- The two-part Startup Checklist will be utilized on all ERH applications.
- Voltage surveys using TRS Standard Operating Procedure 1.0 "Voltage Surveys" must be performed in completing the Startup Checklist.
- All step and touch or step and step voltage potential will be less than TRS's internal safety limit of 15 volts before unattended operations is allowed.
- Engineering controls may be used to achieve the TRS Electrical Safety Standard. Examples of such controls include:
    - Isolation of locations exceeding the TRS Safety Limit by insulating or directly enclosing.
    - Isolation of locations exceeding the TRS Safety Limit by restricting access to qualified personnel when power is applied.
    - Isolation of locations exceeding the TRS Safety Limit by connecting areas of different voltage potentials to eliminate any electrical hazards.

3.2.2 High Temperatures

The ERH technology increases subsurface temperatures to the boiling point of groundwater. Thus the vapor recovery piping, vaults, and objects in or immediately adjacent to, the electrode field(s) may be hot to the touch. Following shutdown, it may take several days or weeks for the steel casings to cool below a safe handling temperature of 60 degrees Celsius (°C) (140°F). Burns may result from contact with these components without the use of proper PPE. Gloves providing protection from burns will be required to handle well attachments during this period. Care should be taken with

regard to these temperatures during any sampling that occurs during active heating and for several weeks following shutdown of the ERH system.

3.2.3 Steam

Steam will be generated in the subsurface during operation of the ERH system. This steam will be present throughout the treatment area. In addition, steam will be present in the vapor recovery piping running from the vapor recovery wells in the vicinity of the treatment area to the condenser, and within the condenser. In some rare instances or material failures, steam may be developed under a positive pressure. Care must be taken to avoid exposing personnel to any source of steam.

4.0 Access Control

Due to the hazards described above, the site must maintain strict access control. No one may enter the remediation area or sample monitoring wells until they have been trained by TRS, have reviewed the work plan and HASP, and signed the training acknowledgement sheet (Attachment A). Prior to performing work in areas that could expose personnel to electrical hazards, trained personnel must lock out and tag out the ERH power control unit as described below. A follow up Hazard Notification Letter will be sent to the appropriate parties prior to commencing ERH operations as reminder of the hazards.

All persons who may need access to this site must be informed of these hazards. The following precautions and notifications must be exercised to ensure that a safe and successful project is implemented:

- A strict **"NO DIG"** policy must be implemented by the site owner or site manager. As a minimum, the policy must include the following:
    - There must be no excavation, drilling, or other subsurface activities conducted within the ERH region, or within 50-feet of the ERH treatment region, during the duration of ERH project that have not been authorized and scheduled by TRS. Such activities include gaining access to any subsurface component such as monitoring wells or subsurface vaults.
- Electrical extension cords **MAY NOT** be used within the boundaries of the ERH treatment region during ERH operations. Devices such as sample pumps and monitoring equipment which use an internal or external battery may be permitted within the treatment region during normal operations, with the prior approval of TRS.

TRS must be notified prior to starting any of these activities within 100-feet of the treatment region. This notification will allow TRS to assess the current operational conditions at the site and to provide necessary hazard mitigation assistance.

If the need arises to conduct any of these activities, TRS must be contacted so that proper safety precautions may be put in place. It is highly likely that the ERH process will have

to be stopped to accommodate intrusive activities, which may hinder the progress of the remediation program.

5.0 Lock Out & Tag Out

Safety related work practices will be used to safeguard employees from injury while they are working on or near exposed electrical conductors or circuit paths that are, or can become, energized. The specific safety-related work practice shall be consistent with the nature of and extent of the associated electrical hazards.

Unless it can be demonstrated that de-energizing components introduces additional or increased hazards or is infeasible due to equipment design or operational limitations, exposed energized electrical conductors or circuit paths to which an employee might be exposed will be put into an electrically safe work condition before an employee works on or near them.

Although safe working practices and professional judgment dictate the use of lock out and tag out, the following is a partial list of activities that usually require lock out and tag out:

- Connecting or disconnecting electrode cables (placing an electrode on service or out of service).
- Personnel entering the power section (rear section) of the PCU.
- Heavy equipment (e.g., crane, drill rig, backhoe, forklift) operation within the fenced area.
- Removal or modification of the CPVC over-sleeve or the cap on an electrode or monitoring well.
- Modifications to the grounding system or other systems that reduce surface induced voltages.
- Soil or groundwater sampling

Authorization of the project manager is required to conduct any of the above activities without lock and tag out.

The following is a partial list of activities that usually do not require lock out and tag out:

- Measuring the current flow to electrodes.
- Adjusting vapor recovery (VR) valve positions.
- Vapor stream sampling

Only personnel experienced or trained to operate or perform maintenance on the ERH remediation equipment or system support components are authorized to conduct the lock

out/tag out procedures summarized below. The following procedures must be followed when the remediation system is being serviced.

1. I will conduct a safety brief with all untrained personnel who will assist me in this work task.
2. I will depress the Output Switch, lock it in the depressed position, hang a danger tag on the switch, and take personal possession of the key.
3. When work is complete, I will personally inspect the electrode field to verify that all access gates are locked shut, all monitoring wells are sealed, and that all personnel have exited the electrode field.
4. I will remove the danger tag from the output switch and unlock the switch. The switch will normally spring return to the mid position; if it remains depressed, gently pull it to the mid-position.
5. I will telephone a Thermal operator to re-start the ERH system.

Brad Pierce	(480) 907 5427	work	(360) 560 4839 cell
Chris Blundy	(843) 225 6018	work	(360) 560 4852 cell
Jerry Wolf	(817) 379 0536	work	(817) 913 4194 cell
Tom Powell	(360) 693-6301	work	(360) 560 4845 cell

6.0 Sampling

Sampling presents special consideration for this health and safety plan. Without proper attention to the considerations in this HASP, sampling can lead to exposure to the hazards detailed above. Sampling must never occur in the treatment area or adjacent areas during ERH operations without the concurrence of TRS. Therefore it is very important that all sampling activities are scheduled as much in advance as possible. This time allows the TRS operators to place the ERH system in a safe condition prior to sampling. Soil or groundwater samples shall never be obtained from an active ERH site with the electrode field energized.

6.1 Soil Sampling

Post remediation soil samples will most likely be collected using a hydraulic push rig due to the shallow depth of sampling that is required. Hydraulic push sampling of hot soil is also inherently safer than auger sampling because hydraulic push will not require operators to handle hot soil cuttings. Although acetate liners are often used for hydraulic push core barrels at other sites, the temperature of the subsurface will require the use of stainless steel, brass, or Teflon™ core barrel liners.

Although the soil samples and core barrels will obviously be hot when extracted from the subsurface, past thermal remediation experience has indicated that standard work gloves or heavy-duty rubber gloves provide sufficient protection for the handling of hot push rods and soil core barrels.

Upon extracting the soil core barrel from the subsurface, the core barrel will be immediately capped using the standard barrel caps provided by the hydraulic push manufacturer and the entire core barrel will be placed on ice for cooling.

When the core barrel is cool (typically 5-15 minutes), the core barrel is removed from ice and a soil sub-sample is collected for analysis by the standard method. As in all soil sampling, care should be taken to select the analysis sub-sample from near the center of the core barrel where evaporative losses are minimized.

Attachment A

Training Acknowledgment

ERH Exclusion Zone Training Acknowledgement

I have been trained by Thermal Remediation Services in the proper lock-out and tag-out requirements to enter the electrode field. My responsibilities are:

1. I will conduct a safety brief with all untrained personnel who will assist me in this work task.
2. I will depress the Output Switch, lock it in the depressed position, hang a danger tag on the switch, and take personal possession of the key.
3. When work is complete, I will personally inspect the electrode field to verify that all access gates are locked shut, all monitoring wells are sealed, and that all personnel have exited the electrode field.
4. I will remove the danger tag from the output switch and unlock the switch. The switch will normally spring return to the mid position; if it remains depressed, gently pull it to the mid-position.
5. I will telephone a Thermal operator to re-start the ERH system.

Miles Stumbaugh	(828) 994 0035	work	(360) 560 4857 cell
Chris Blundy	(843) 225 6018	work	(360) 560 4852 cell
Jerry Wolf	(817) 379 0536	work	(817) 913 4194 cell
Tom Powell	(360) 693-6301	work	(360) 560 4845 cell

Date	Training Acknowledgement	TRS Trainer
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

APPENDIX B

BASELINE SAMPLING WORK PLAN

Appendix X
QAPP, Field Sampling Plan, and Health and Safety Plan
Site 22 – Building 105, Old Dry Cleaning Facility
ERH Treatability Study Work Plan
Naval Station Great Lakes

The purpose of this Work Plan is to provide details on the sampling that will be conducted to obtain additional baseline data for the electric resistance heating (ERH) treatability study to be conducted at Site 22 in Naval Station (NS) Great Lakes. The Work Plan was developed based on the previous sampling results shown on Figure 1. This Work Plan provides information on the number and location of samples to be collected, the rationale for each sample, and the analytical parameters for each sample.

The work to be completed at the site will be conducted in accordance with the Quality Assurance Project Plan (QAPP) for NS Great Lakes (revised June 2003) and specifically Appendix IX, which was prepared for the Remedial Investigation at Site 22. The QAPP presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the Site 22 - Building 105 Old Dry Cleaning Facility at NS Great Lakes. Specific protocols for sampling, sample handling and storage, chain of custody, and laboratory and field analyses are also described. The June 2003 QAPP also incorporates the Health and Safety Plan (HASP) for the site; minor changes to the HASP (contact information) are attached to this Work Plan.

There are three primary goals associated with this sampling:

- Confirm the concentrations of chlorinated volatile organic compounds (cVOCs) in the location of historical soil sample GL95-105S-13 to properly locate the ERH treatability study area and provide baseline data for the ERH Treatability Study;

- Obtain additional baseline soil and groundwater samples within the ERH area to assist in determining the effectiveness of ERH in reducing the concentrations of cVOCs at the site; and

- Obtain confirmatory data on surface and near-surface soil samples collected historically outside of the ERH area. This data will be used to determine if additional excavation or an expanded ERH treatment area is required.

The soil samples will be collected via direct push technology (DPT) and the groundwater samples will be collected via low flow sampling. See the QAPP for sample collection techniques and sample handling procedures. The samples will be analyzed for the cVOCs listed in Table 1 via SW-846 Method 8260B.

Sampling at GL95-105S-13. In this area, which lies near the southwestern corner of the proposed ERH treatability study area, historical data shows high concentrations of cVOCs at a depth of 6 feet. To confirm that this contamination is still present and to provide baseline data for the ERH treatability study, a boring (NTC22SB20) will be advanced at this location. Samples will be collected at depths of 2 to 3 feet and 5 to 6 feet. If this location becomes part of the ERH area, the results from Boring NTC22SB20 will be utilized as part of the ERH baseline data set.

ERH Baseline Samples. In order to provide baseline samples to measure the effectiveness of ERH in reducing cVOC concentrations in the soil, two additional soil borings (NTC22SB21 through NTC22SB22) will be advanced (Figure 2). In each soil boring, three soil samples will be collected from different depth intervals. These depth intervals will vary based on the proximity of the sample to previous sample locations and are presented in Table 1.

Baseline groundwater samples will be collected from the four monitoring wells in the vicinity of the ERH area: NTC22MW05S, NTC22MW06S, NTC22MW10S, and NTC22MW10D.

Confirmatory Soil Samples. Three additional borings will be advanced in the locations of historical samples GL-95-105S-2, GL-95-105S-8, and GL-95-105S-10. At each of these locations, a sample will be collected from 0 to 1 foot below the asphalt/HDPE liner. The purpose of these samples will be to determine if cVOC concentrations are still present in the surface soils at these locations following building demolition, limited soil excavation, and other site activities. These boring locations (NTC22SB23, NTC22SB24, and NTC22SB25) are shown on Figure 2.

The results of this sampling event will be reported in the ERH Treatability Study Work Plan to be submitted prior to implementation of the study.

TABLE 1

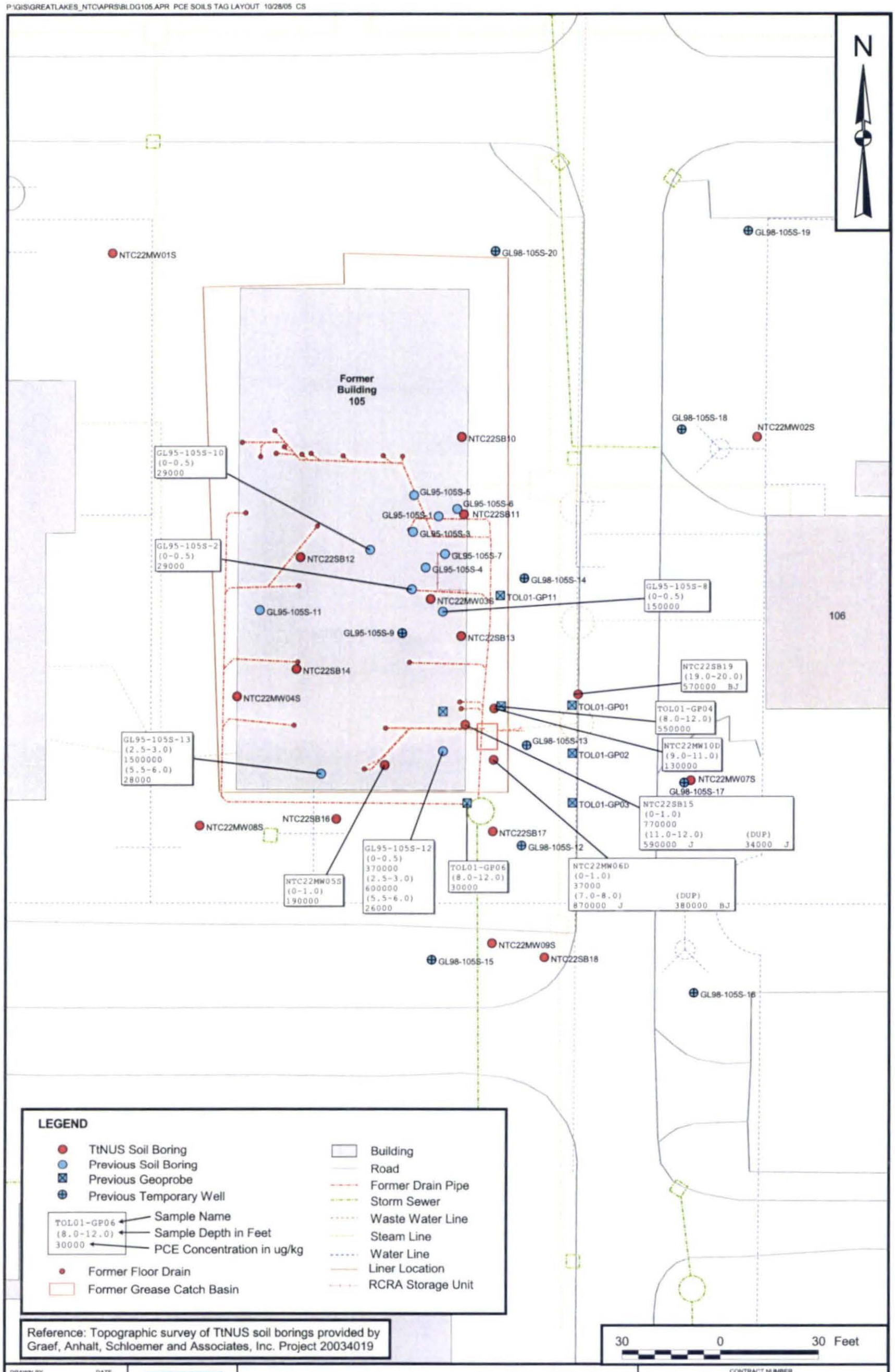
SAMPLE LOCATIONS, DEPTH, AND INTENDED DATA USE
SITE 22 – BUILDING 105 OLD DRY CLEANING FACILITY
NAVAL STATION GREAT LAKES, ILLINOIS

Sample Location	Sample Depth Interval(s)	Analytical Parameters	Number of Samples	Intended Data Use
Soil Sample Locations				
NTC22SB20	2' - 3', 5' – 6'	cVOCs[1]	2	Confirm analytical results from historical sample GL95-105S-13 and provide baseline data for the ERH Treatability Study.
NTC22SB21	2' - 3', 7' - 8', 11' – 12'	cVOCs	3	ERH Treatability Study baseline samples.
NTC22SB22	2' - 3', 7' - 8', 11' – 12'	cVOCs	3	
NTC22SB23	0' - 1', 2' - 3'[2]	cVOCs	2	Historical sample confirmation.
NTC22SB24	0' - 1', 2' - 3'[2]	cVOCs	2	
NTC22SB25	0' - 1', 2' - 3'[2]	cVOCs	2	
Groundwater Sample Locations				
NTC22MW05S	NA	cVOCs	1	ERH Treatability Study baseline samples.
NTC22MW06S	NA	cVOCs	1	
NTC22MW10S	NA	cVOCs	1	
NTC22MW10D	NA	cVOCs	1	
QA/QC Samples				
Soil Duplicates	--	cVOC	2	QA/QC samples
Groundwater Duplicates	NA	cVOC	1	
Field Blank	NA	cVOCs	1	
Trip Blank	NA	cVOCs	1	
Rinsate Blank	NA	cVOCs	1	
TOTAL			**24**	

(1) cVOCs – Chlorinated volatile organic compounds that will be analyzed for as part of this scope include 1,1,1-Trichloroethane, 1,1,1,2-Tetrachloroethane, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichlorethane, 1,1-Dichloroethane, 1,1-Dichloroethene, 1,2-Dichloroethane, Carbon Tetrachloride, Chloroethane, Chloromethane, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Tetrachloroethene, Trichlorethene, and Vinyl Chloride. The analytical method is SW-846 8260B.

(2) Soil samples will be collected 0 to 1 foot and 2 to 3 feet below the liner in native undisturbed soil.

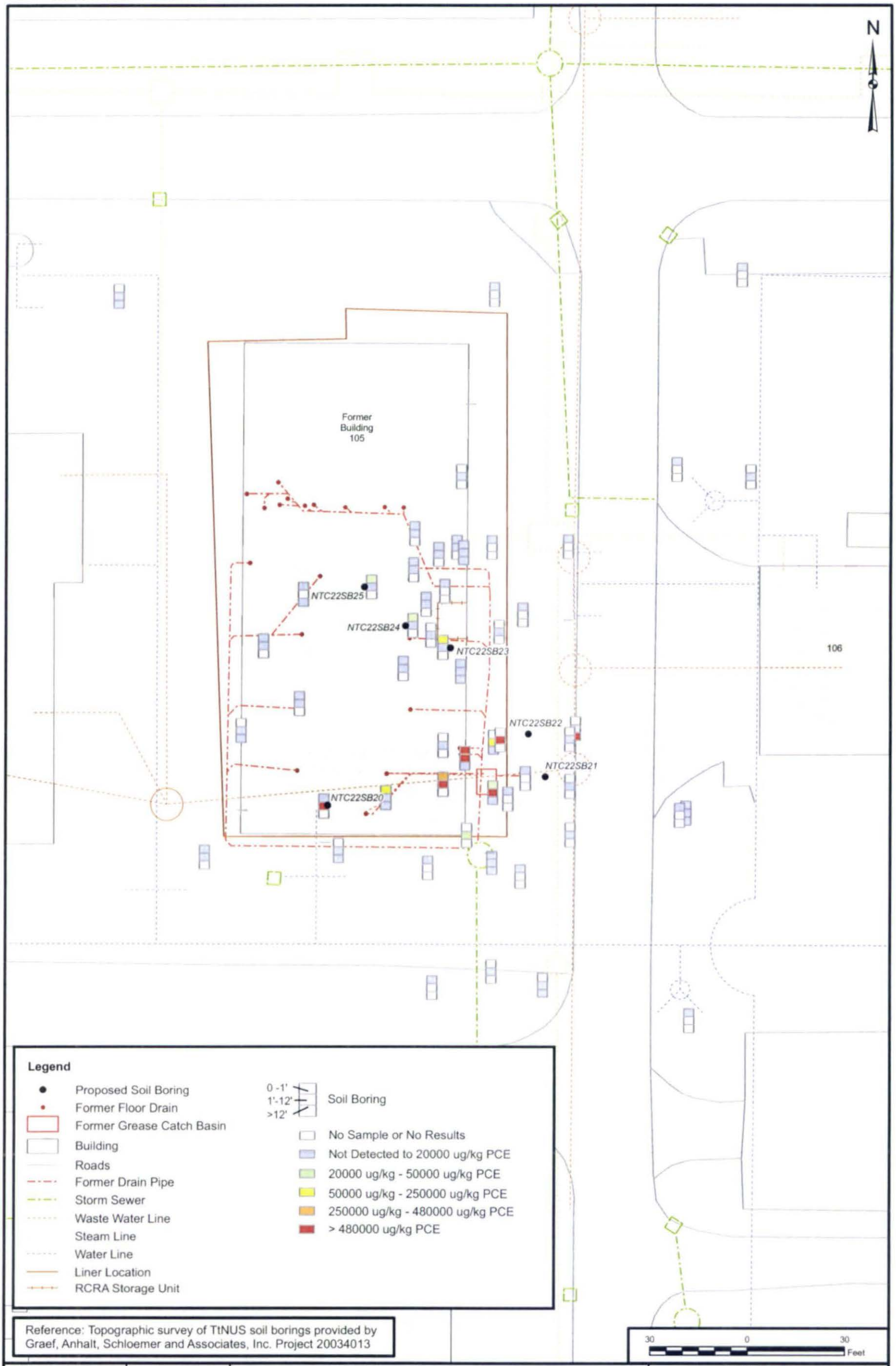
P:\GIS\GREATLAKES_NTC\APRS\BLDG105.APR PCE SOILS TAG LAYOUT 10/28/05 CS



DRAWN BY C. SPEHAR	DATE 10/13/05	SOIL SAMPLE RESULTS FOR PCE SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY NAVAL STATION GREAT LAKES, ILLINOIS	CONTRACT NUMBER 00202
CHECKED BY C. PIKE	DATE 10/13/05		APPROVED BY RFD / DATE 10/14/05
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 1 / REV 0

NAVFAC

P:\GIS\GREATLAKES_NTC\MAPDOCS\MXD\SITE22_SAMPLE_LOCS.MXD 10/28/05 CS



Reference: Topographic survey of TtNUS soil borings provided by Graef, Anhalt, Schloemer and Associates, Inc. Project 20034013

DRAWN BY	C. SPEHAR
DATE	10/13/05
CHECKED BY	C. PIKE
DATE	10/13/05
REVISED BY	___
DATE	___
SCALE	AS NOTED

NAVFAC

PROPOSED BASELINE SAMPLE LOCATIONS
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY
NAVAL STATION
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	00202
APPROVED BY	RFD
DATE	10/14/05
APPROVED BY	___
DATE	___
FIGURE NO	FIGURE 2
REV	0

Health and Safety Plan
for
Remedial Investigation & Risk Assessment & ERH Treatability Study
at
Site 22 Building 105 Old Dry Cleaning Facility

Naval Station Great Lakes
Great Lakes, Illinois

Southern Division
Naval Facilities Engineering Command

Contract No. N62467-94-D-0888
Contract Task Order 0154/0290

Contract No. N62467-04-D-0055
Contract Task Order 0009

July 2001
Revised July 2002
Revised June 2003
Revised October 2005

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: Naval Station Great Lakes **Address:** NAVFAC Midwest
Building 1A, Code N457
201 Decatur Avenue
Great Lakes, IL 60088

Naval Station Great Lakes Point of Contact: Mr. William Busko or Mr. Mark Schultz

Phone Number: Bill - (847) 688-5999 x 154 **E-Mail:** william.busko@navy.mil

Phone Number: Mark - (847) 688-5999 x 140 **E-Mail:** mark.r.schultz@navy.mil

Fax Number: (847) 688-2319

U.S. Navy Remedial Project Manager/Engineer-In-Charge: Anthony Robinson (Code 18511)

Address: 2155 Eagle Drive
North Charleston, South Carolina 29406

Phone Number: (843) 820-7339
Fax Number: (843) 820-7465
E-mail Address: anthony.b.robinson@navy.mil

Base Pass and Security: Building 130 (near Main Gate); Hours of Operation 0600 – 1800

Phone Number: (847) 688-5648

Note: See Section 9.5.1 for Base Access Information.

Purpose of Site Visit: This activity is divided into a multi-task operation (see Section 4.0) including Direct-push technology [DPT] soil borings and groundwater sampling.

Proposed Dates of Work: November 2005

Project Team:

Tetra Tech NUS Personnel:	Discipline/Tasks Assigned:	Phone No.
Robert Davis, P.E.	Task Order Manager	(412) 921-7251 davisb@ttnus.com
Chris Pike, P.E.	Assistant Task Order Manager	(412) 921-8861 chris.pike@ttnus.com
Matthew M. Soltis, CIH, CSP	CLEAN Health and Safety Manager	(412) 921-8912 soltism@ttnus.com
Thomas M. Dickson, CSP	Project Health and Safety Officer	(412) 921-8457 dicksont@ttnus.com
To Be Determined	Project Geologist/Field Operations Leader (FOL)	(412) 921-7090

APPENDIX C

THERMAL REMEDIATION SERVICES, INC. DESIGN AND WORK PLAN

Design and Work Plan
Electrical Resistance Heating
Treatability Study
Site 22, Naval Station Great Lakes, IL

April 12, 2006

Prepared by:

Thermal Remediation Services, Inc.
2325 Hudson Street
Longview, Washington 98362

Table Of Contents

ABBREVIATIONS AND ACRONYMS

bgs	below grade surface
CPVC	chlorinated polyvinyl chloride
Db	decibels
DNAPL	dense non-aqueous phase liquids
ERH	electrical resistance heating
FID	flame ionization detector
ft bgs	feet below grade surface
GAC	granular activated carbon
gpm	gallons per minute
Hc	Henry's Law constant
hp	horsepower
in H_2O	inches of water column vacuum
in Hg	inches of mercury vacuum
ISO	International Standardization Organization
kW	kilowatt
kW-hr	kilowatt hour
MW	monitoring well
PCE	perchloroethylene (tetrachloroethene)
PCU	power control unit
PID	photo-ionization detector
ppb	parts per billion
psig	pounds per square inch gage
PVC	polyvinyl chloride
scfm	standard cubic feet per minute
SVE	soil vapor extraction
TCE	trichloroethene
TMP	temperature monitoring point
TOC	total organic carbon or fraction organic carbon
TRS	Thermal Remediation Services
VOC	volatile organic compounds
VC	Vinyl Chloride

VR	vapor recovery

1.0 Introduction

This Treatability Study Design and Work Plan (WP) describes the technical approach Thermal Remediation Services, Inc. (TRS) proposes to treat chlorinated volatile organic compound (CVOC) contamination in soil at Site 22 located on the U.S. Naval Station in Great Lakes, Illinois (the Site). The treatment technology is an *in-situ* thermal process of electrical resistance heating (ERH). This Treatability work is being done for the Navy under direction from Tetra Tech NUS., Inc Contract No.1007413.

The performance objective is to reduce CVOC concentrations in soil by 95.5%, which will reduce CVOC concentrations to less than an average value of 20 mg/kg.

2.0 Project Description

2.1 Site Description

Site 22 consists of a former dry cleaning facility that operated in former Building 105 until 1993 or 1994. The building has been demolished and the area and surrounding lot are now used for vehicle parking. The remediation area is located in the southeastern portion of the active parking lot. The southern area of the parking lot required for the remediation will be isolated for approximately 4 months by an exclusion fence. There is a Fire Department to the east of the Site and Navy personnel housing to the south.

There are three regions within the treatability study area. The approximate areas, depth of treatment intervals, and treatment volumes of each region are described in Table 1. The total treatment area is approximately 2,400 square feet (sq ft), the average depth interval requiring treatment is from 0.5 – 17 feet below ground surface (ft bgs), and the resulting total treatment volume is approximately 1,400 cubic yards (yds^3).

Table 1. Treatment Regions*

Region	Treatment Area (sq ft)	Depth Interval (ft bgs)	Volume (yd^3)
Area 1	300	0.5 – 25	300
Area 2	1,425	0.5 – 18	900
Area 3	675	0.5 – 8	200
Total	**2,400**		**1,400**

* The treatment regions are defined on Figure 2 "ERH Treatment Area and Depths" of the TtNUS RFP.

The chlorinated volatile organic compounds of concern (CVOCs) identified in the treatment area include tetrachloroethene (PCE), trichloroethene (TCE), *cis* 1,2-dichloroethene (DCE) and vinyl chloride (VC). The remediation goals will be based upon total CVOC concentrations.

The maximum and average initial CVOC concentrations in soil are provided in Table 2.

Table 2. Initial Concentrations of CVOCs in Soil*

CVOCs	Maximum Concentration in Soil (µg/kg)	Average Concentration in Soil (µg/kg)
PCE	1,500,000	436,953
TCE	10,000	2,247
DCE	52,000	6,115
VC	ND	ND
Total CVOCS	**1,562,000**	**445,315**

Notes:

* The values in Table 2 were defined in "Table 1 Baseline Soil Data" contained in the RFP.

ND Non-detect

TRS has estimated a total CVOC mass of 1,663 pounds. This estimate is the product of the average baseline CVOC concentration of 445,315µg/kg and the treatment volume of 1,400 yds^3. Likewise, an average final concentration of 20,000µg/kg would result in an approximate remaining mass of approximately 75 pounds of CVOCs at the site.

Site lithology in the treatability area consists of gravel and silty-clay and cinders in the vadose zone and clay, silt, sand and gravel in the saturated zone. Groundwater is encountered on average across the site at approximately 5 ft bgs.

As part of the treatability study, TRS will evaluate treatment by comparing soil samples collected prior to heating (baseline), during heating, and when the project is completed (confirmatory). Some of the metrics used to help measure the progress in the ERH application will be: power application rates, total energy input to the subsurface, condensate production rates and totals, vapor stream contaminant concentrations, and subsurface temperatures.

2.2 Technical Approach

The treatment approach consists of utilizing the ERH technology to heat the subsurface volume to the boiling point of water to volatilize and steam strip the CVOCs from the site. TRS estimates that approximately 328,000 kW-hrs of electrical energy will be applied to the subsurface in order to achieve the established treatment goals. The operating time required to apply this amount of energy to the subsurface will be approximately 51-62 days. As mentioned above, the primary removal mechanisms are volatilization and steam stripping of the contaminants from the subsurface. However, other *in situ* treatment processes are at work to some degree as a result of the elevated subsurface temperatures. These other processes are discussed in detail in section 3, Treatment Technology Description.

Air and CVOCs recovered from the subsurface are routed through above grade conveyance piping to the steam condenser and on through granular activated carbon (GAC) to the VR blower and discharged to the atmosphere. A process flow diagram for the ERH remediation system is presented as Figure A.4.

3.0 Treatment Technology Description

3.1 Electrical Resistance Heating (ERH)

ERH passes an electrical current through the soil and groundwater that requires treatment. The electrical current warms the soil and then boils a portion of the soil moisture into steam. This *in situ* steam generation occurs in all soil types, regardless of permeability. Electrical energy evaporates the target contaminant and provides steam as a carrier gas to sweep the CVOCs to the vapor recovery (VR) wells. After the steam is condensed and the extracted air is cooled to ambient conditions, the CVOC vapors are treated using conventional methods.

The type of contaminant and the desired clean-up goal affect the energy, time and cost to remediate a site. However, two subsurface parameters are particularly important: the amount of total organic carbon (TOC) and the presence of heavy hydrocarbons such as diesel, oil, or grease.

TOC preferentially adsorbs CVOCs in comparison to water; this is why activated carbon is often used for vapor and water treatment. TRS typically assumes 0.25% soil TOC unless site-specific information is known. Based on the site information provided by TtNUS, it appears that the subject site has higher than average TOC. TRS has used 0.678% TOC in defining the ERH operating parameters for the Site.

The presence of oil, grease, or other low volatility hydrocarbons can also slow the evaporation rate of CVOCs. Raoult's Law describes this effect. No significant concentrations of oil or grease have been reported at the Site.

Dalton's Law of Partial Pressures

The boiling point of PCE is above the boiling point of water, 100 degrees Celsius (°C) at sea level pressure conditions. It should be noted that when a CVOC is immersed or dissolved in water, the combined boiling point is depressed as described by Dalton's Law of Partial Pressures. Dalton's Law even describes the boiling temperature of non-aqueous phase liquids (NAPLs) in contact with moist soil. Consequently, the CVOC/water mixture will boil when the vapor pressure of the CVOC plus the vapor pressure of water is equal to the ambient pressure.

Once subsurface heating starts, the boiling points of various CVOC/water mixtures are reached in the following order: separate phase NAPL in contact with water or soil moisture, followed by dissolved CVOCs, and finally, uncontaminated groundwater. This order is advantageous for remediation because contaminated water will tend to boil off before uncontaminated water, reducing the time and energy required to complete treatment.

In contact with water, the boiling point of PCE is reduced to approximately 87°C based on the Dalton's Law effect. Within the vadose zone, the flow of air will cause evaporation to occur at temperatures below this boiling point. Calculated boiling temperatures at various depths of the significant CVOCs at the Site are described in Table 3.

Table 3. Boiling Temperatures of CVOCs at Various Depths

CVOC	Boiling Temperature in Contact with Air	Boiling Temperature in Contact with Water or Moist Soil	Boiling Temperature at 8 ft bgs	Boiling Temperature at 25 ft bgs
Pure Water	100°C	100°C	102°C	114°C
PCE	121°C	88°C	90°C	101°C
TCE	87°C	73°C	75°C	86°C
cis 1,2-DCE	59°C	54°C	56°C	67°C
VC	-14°C	-14°C	-12°C	-4°C
CVOC Mixture*	116°C	87°C	89°C	100°C

* A mixture of CVOCs will boil at an intermediate temperature, in proportion to the fraction of each in the liquid mixture (as described by Raoult's Law). The calculated CVOC mixture boiling temperature shown here is based on the NTC22MW06D soil sample collected at 7-8 ft bgs in which the molar fraction of each CVOC was: 97% PCE, 1% TCE, and 2% cis 1,2-DCE.

Other *In Situ* Treatment Process Enhancements Resulting From ERH

Although volatilization is usually the primary removal mechanism for CVOCs, TRS has documented on several sites that a significant fraction of the CVOCs will be degraded in place by other *in situ* processes. Depending on the site, these *in situ* processes may include biodegradation, hydrolysis, and reductive dehalogenation by zero valent iron.

Biodegradation

The biodegradation of chlorinated CVOCs is most commonly observed as an anaerobic process. Elevated temperatures increase biotic reaction rates. This mechanism is especially important at sites where relatively high levels of TOC or non-chlorinated hydrocarbons provide a carbon source that serves as an electron donor.

When soils with high levels of TOC are heated, some portion of the humus will convert to more water-soluble forms, including acetone. Acetone is a CVOC, but it also provides an easily biodegradable food source for reductive dechlorination by soil microbes. When ERH remediation is completed, any acetone generated will provide a polishing effect on residual chlorinated compounds and acetone concentrations less than 500 mg/l will rapidly biodegrade to non-detectable levels as the site cools to ambient conditions. Because the Site has only moderate levels of TOC, acetone is likely to remain non-detectable throughout the remediation.

Hydrolysis

Hydrolysis is a chemical substitution reaction in which hydrogen ions in water react with organic molecules, replacing chlorine atoms. Oxidizing conditions or available oxygen is not required for hydrolysis. Hydrolysis can be a significant degrader of some CVOCs at room temperature; especially halogenated alkanes. The rate of hydrolysis increases with temperature and clay soil types tend to accelerate hydrolysis. Hydrolysis will not be a significant mechanism for the destruction of CVOCs at the Site.

Reductive Dehalogenation

The backfill of our electrodes include steel shot, which is a form of zero valent iron. The reductive dehalogenation process that takes place at the electrode backfill is the same as that produced by an iron-filing remediation wall. Reductive dehalogenation is not likely to be a large mechanism for CVOC mass removal at the Site; however, the presence of iron in the electrode boreholes might provide a significant polishing mechanism for dissolved phase CVOCs after heating has ended.

Hydrolysis and reductive dechlorination are strongly affected by temperature as described by the Arrhenius Equation. In essence, each 10°C increase in temperature will increase the reaction rates by a factor of about 2.5.

4.0 Project Objectives

4.1 Performance Objectives

A successful implementation of ERH will heat soil and groundwater throughout the treatment volume to a temperature that allows CVOC vapors to be recovered and treated by the vapor recovery system. The performance objective is to reduce CVOCs concentrations in soil by 95.5% with the average soil sample CVOC concentrations less than 20 mg/kg.
The actual percentage of CVOCs removed from the treatment volume will be measured by comparing soil analytical data collected before, during, and after the ERH remediation.

4.2 Remedial Objectives

The in-situ thermal system design will maximize vapor recovery, minimize time to implement, and meet the required temperatures and treatment duration for the vadose and saturated zones at Site 22. These requirements are that the system will provide energy sufficient to increase the soil and groundwater temperature in the treatment area to achieve the clean-up goals of CVOCs as follows:

Reduce average soil concentrations to less than 20.0 mg/kg CVOCs

Additionally, the in-situ thermal remediation system design shall accomplish the following:

- Control in-situ pressure to prevent the migration of steam, vapors, or water to the ground surface,
- Recover and treat vapors to remove, recover, or destroy CVOCs, and
- Operate the vapor treatment components of the remediation system to meet atmospheric discharge standards.

The remediation design will include instrumentation and control systems that allow timely data acquisition, reporting, interpretation, and decision making to verify that operational requirements are being met in order to optimize each component of the remediation system. These systems will also ensure that the treatment progress is accurately tracked, that the rate and volumes of CVOC removal are measured, and that regulatory standards are being complied with.

4.3 Project Schedule

Field work for the ERH system will begin on Monday, April 17, 2006 with material delivery and setup for drilling. Subsurface and surface completion will total approximately three to four weeks with system shakedown and startup beginning immediately after, between May 8-15, 2006. The system will operate for approximately 60 days and will be taken offline when confirmatory samples indicate the cleanup goal has been met. A detailed schedule of the project is provided below in graph A.6.

5.0 System Design

5.1 ERH Process Flow

During ERH operations, standard 3-phase electrical power is secured from an available utility power service to an ERH Power Control Unit (PCU). The voltage is reduced to the appropriate level for application to the subsurface. During the treatment, it is expected that the applied voltage to the subsurface at the electrodes will range from 300 to 500 volts. As the subsurface resists the movement of the electrical current between electrodes, it is heated to the boiling point of site groundwater.

Electrical energy will be applied over the depth interval of approximately 2 to an average of 17ft bgs. As this subsurface region is heated, CVOCs will be volatilized and groundwater and soil moisture boiled. Volatilized VOCs and steam will migrate upward to be collected in co-located VR wells.

Once collected at the VR wells, soil vapors and contaminant-laden steam are transported through the vapor recovery conveyance piping to the ERH steam condenser where soil vapors and CVOCs are separated from steam. Over 99% of the resulting condensate is recycled in the condenser system as makeup cooling water and as electrode drip water. By recycling the condensate for productive uses, TRS reduces the need for excess water disposal.

Air and VOC vapors pass from the condenser through granular activated carbon (GAC) to the VR blower and treated air is discharged to the atmosphere. A total of 8,000 pounds of GAC is

anticipated for this treatment. A process flow diagram for the ERH remediation system is presented as Figure A.4.

5.2 ERH Power Control Unit

The ERH PCU adjusts the voltage of electrical energy from the utility power service for optimum subsurface heating. This equipment is manufactured specifically for use in ERH applications. The ERH PCU selected for the treatment is designed for 100% cycle duty and sized for a maximum power output of 500 kilowatts (kW). Over the course of the treatability study, the assumed average power output from the ERH PCU will be approximately 241 kW.
PCU control and data acquisition are performed on a dedicated computer running the Windows™ operating system. Remote data acquisition software is used to collect and store temperature, power, voltage, electrical current and operational status data. Operations personnel can access the data acquisition system to download data, or monitor and control the ERH process either directly or remotely by phone modem.

Power will be supplied to the PCU via a directionally bored conduit for a high voltage switch approximately 200-feet south of the treatment area. The high voltage primary will exit the buried conduit and connect to a pad mounted 500 kVA step down transformer with an output voltage of 480 volts. The secondary side of the transformer will have a 600 amp service disconnect for system isolation before connecting to the primary side of the PCU. The primary electrical service installation will be performed by a licensed electrical contractor (Aldrige Electric).

5.3 ERH Electrode Design

Site 22 will require a total of 16 electrodes. The site is separated into three distinct regions each with a specific heating interval. The three regions and the electrode depth information for each are shown in figure 4.

Table 4. Region Volumes and Electrode Arrangement

	Volume (yd^3)	Treatment Depth (feet bgs)	Electrode Conductive Interval	Linear feet of fine sand per borehole	Linear feet of neat Portland per borehole	Number of Electrodes
Region 1	300	0.5 ft to 25 ft.	1.5 ft. to 25 ft.	0.5	1.5	2
Region 2	900	0.5 ft to 18 ft.	1.5 ft. to 19 ft.	0.5	1.5	10
Region 3	200	0.5 ft. to 8 ft.	1.5 ft. to 9 ft.	0.5	1.5	4

Each slotted steel pipe electrode will be installed within a 12-inch diameter borehole through 8 ¼-inch hollow stem augers. The annular space surrounding the electrically conductive interval of each electrode is filled with a combination of steel shot and graphite to expand the effective

diameter of the electrodes. In the shallow portion, where the electrode is not electrically conductive, (from 0 to 2-ft bgs) the annular space is filled with non-conductive materials such as sand and neat cement grout. This interval near the surface is required for constructing a surface seal to prevent steam and CVOCs from escaping to the atmosphere. A vapor recovery screen is co-located with the electrodes to remove steam and CVOC vapors from the vadose zone and to remove steam from the saturated zone directly. Electrode completion details are provided on Figure A.2. Electrodes will be positioned at an average spacing of 13.5-ft on center.

A pharmaceutical-grade Epsom salt (magnesium sulfate) solution will be used to hydrate the electrode materials during construction. Epsom salt is edible and inert and electricians commonly use this material in the installation of subsurface electrical grounding and cathodic protection systems. Approximately one gallon of Epsom salt solution will be added per foot of electrode from 2 to 6-ft bgs to hydrate the electrode construction materials during installation.

A significant portion of the electrodes are completed within the saturated zone. The hydraulic conductivity of this zone is likely to keep the electrodes wet throughout the remediation. However, if the electrodes and the immediately adjacent soil were to dry out, this would increase the local electrical resistance and lead to uneven heating. If "dry out" is observed as a decrease in electrode current, a small amount of treated recirculation water will be dripped into the electrodes to keep the vadose zone soil adjacent to the electrodes moist. During system installation a ½" drip water hose will be routed inside the borehole with the electrode. Treated recirculation water is described in section 5.8 below.

5.4 Temperature Monitoring Points

During the treatability study, subsurface temperatures will be measured at the three temperature monitoring points (TMPs), located within the treatment area. These TMPs will be used to track the heating process and ensure that the desired subsurface temperatures are achieved.

Each TMP will be installed to the treatment depth of each area. The temperature monitoring depths are shown in Table 5.

Table 5 Temperature Monitoring Depths (Feet bgs)

Region 1 (TMP-1)	Region 2 (TMP-2)	Region 3 (TMP-3)
1	1	1
5	5	5
10	10	8
15	15	
20	18	
25		

Each TMP will contain ANSI Type-T thermocouples placed at 5-foot depth intervals. Each casing will be grouted into place with neat Portland cement for its entire length. Thermocouples in the TMPs will be monitored continuously using the ERH control system.

A TMP detail drawing is provided in Figure A.2.

5.5 Surface Insulating Layer

To improve treatment of very shallow soil and to increase energy efficiency, TRS will install a thermally insulating surface cover over the remediation area. This insulation is composed of a product called Astro-foil and will be installed beneath the power cables and vapor conveyance piping.

5.6 Vapor Recovery System

Soil vapor extraction (SVE) is an established remediation technology that is commonly used to extract volatile compounds from unsaturated soil. During SVE, a vacuum is applied to an extraction well to lower the pressure in the vicinity of the well. Application of a vacuum at the extraction well induces an advective flow of soil vapors from regions of higher pressure to the extraction point. This process can enhance the volatilization of contaminants and promote the diffusion of sorbed contaminants into soil pores where they can be extracted along with soil vapors. However, SVE systems are notorious for effectively remediating sandy zones while leaving lower permeability units untreated. Effective SVE requires careful system design to try to drive subsurface airflow through all soil types.

In contrast, during ERH, steam is generated in all soil types, regardless of permeability. The generation of *in situ* steam makes up the majority of the subsurface flow and therefore governs the small-scale flow patterns. During ERH, a vacuum is applied to the VR wells only to establish the vadose zone subsurface vacuum influence necessary to recover vapor and prevent steam from moving outside the treatment region. This simpler task is referred to as vapor recovery (VR) to contrast it with the more difficult task of SVE.

Design specifications for the vacuum blower and the vapor treatment systems used during ERH are based on the flow of air only. At startup of ERH, no steam is generated in the subsurface. The blower exerts a vacuum on the VR wellheads and air in the subsurface flows toward the VR well screens. As ERH continues, a small amount of steam is generated. That steam rises into the vadose zone and is swept toward the VR wells by the air flowing to the VR well screens.

At the ERH condenser, steam is converted to condensate water and thus has no effect on the capacity of the VR blower regardless of the rate of steam production. The amount of steam generated during ERH is not a component of the VR blower design specifications. As ERH progresses, and steam production increases, steam migrating into the vadose zone will continue to move into the VR well screens since it can not move counter to the subsurface air flow created by the VR blower. As the treatability volume approaches full steaming, the vacuum applied by the blower may increase slightly due to head losses resulting from the increased total volumetric flow through the piping system. However, the subsurface airflow pattern and vapor capture radii at the VR wells will not change.

Prior experience with vapor recovery systems indicates that a vapor recovery well installed within a sandy soil vadose zone will yield a radius of influence of about 30 feet with an applied vacuum of about 4 inches of mercury (in. Hg). This design is based on the use of co-located

vapor recovery wells in all 16 electrode boreholes in order to provide a large margin-of-safety. The use of a large number of extraction points provides assurance that subsurface heterogeneity will not adversely affect vapor recovery. The total air extraction rate is estimated to be approximately 130 standard cubic feet per minute (scfm).

The extraction of 130 scfm of air from the subsurface will be sufficient to provide complete recovery of steam and heated soil vapors during the remediation. It is estimated that a vacuum of about 2 in. Hg will be required to achieve design flow from the VR wells. This flow and vacuum requirement can be met by using a 5 horse power (hp) rotary lobe blower. However, a minimum 15 hp blower is specified to provide further margin-of-safety and the VR system will be capable of applying up to 15 in. Hg., if necessary.

For an ERH remediation, VR piping must be sized for the combined flow of soil vapors and steam and is thus relatively larger than in standard SVE systems. Header piping must also be heat resistant and constructed of chlorinated polyvinyl chloride (CPVC). A thermocouple will be installed to measure extracted vapor temperatures prior to the condenser. Vapor recovery wells will be connected with 1½ inch diameter piping while the header manifold will be constructed of up to 4-inch piping.

The VR wells will be extended above grade, and wellheads consisting of a 90-degree elbow and an instrument run, will be constructed of CPVC pipe and fittings. The instrument run may include a threaded port to allow vacuum monitoring and vapor sampling. A ball valve is included on the VR blower end of the instrument run. VR header piping will be constructed of CPVC pipe to the inlet of the condenser and of polyvinyl chloride (PVC) or CPVC pipe after the condenser.

5.7 VR Blower

The vapor recovery blower is a skid mounted, sound enclosed package utilizing a 15-hp positive displacement blower. The blower will also have an inlet and dual outlet silencers for added noise reduction. Positive displacement blowers are best suited for applications of high vacuum and relatively high flow. The blower inlet will be connected to the outlet of the secondary GAC vessels and the blower outlet will be connected to the atmosphere discharge stack. Sampling ports and gauges will be supplied to measure vacuum, flow, and temperature at the blower inlet and temperature at the blower outlet. Vacuum and temperature will be measured by gauge, while flow is measured by anemometers. The blower will be monitored for noise production and kept below the facility noise limit of 60 decibels (db). Additional noise control devices such as sound walls or enclosure will be added to the ERH system to maintain noise production below 60 db at all noise receptors. Noise receptors for this project are defined as the outside of Building 106 to the east and Buildings 4 and 178 to the south.

5.8 VR Wells

A vapor recovery (VR) screen is co-located with each electrode to capture VOC vapors and steam mobilized by the ERH process. The 0.040-inch slot VR well screens will be installed at depths ranging from 2 to 5 ft bgs and will be surrounded by conductive backfill. The construction details for the co-located vapor recovery/electrode are shown in figure A.4.

As the site is heated, the first important physical process is de-aeration of the groundwater. The solubility of gases in water decreases with temperature and small bubbles of air and water vapor form. This process is routinely observed whenever water is boiled on a stove – the first bubbles that form (and tend to stick temporarily to the sides of the pot) are air bubbles. With continued heating, steam bubbles form and dance on the bottom of the pot (nucleate boiling), and then finally a rolling boil is reached.

De-aeration is an important remedial process that begins before the boiling temperature of water is reached. The total de-aeration bubble volume varies from site to site but is generally greater than 3 volume percent of the groundwater and can carry a considerable mass of VOCs though Henry's Law partitioning. For example, de-aeration of groundwater can remove over 10% of the dissolved PCE that it contains.

The VR system has been over-designed in density of extraction wells, lateral extent of influence, applied vacuums, and subsurface flow rates to ensure complete capture of vapors and steam. A plot plan of the VR well system is contained in Figure A.4.

5.9 Steam Condenser System

The ERH condenser separates soil vapors from steam, performs as a liquid/vapor separator, air strips steam condensate prior to discharge or re-use, and provides automated condensate pumping functions. The vapor outlet of the condenser contains a liquid/vapor knockout system and includes a mist eliminator that is 99% efficient in removing droplets to a size of 10-microns. When connected to a vacuum blower, the pressure drop across the condenser is less than 0.5-pounds per square inch (psi), which is equivalent to approximately 1-in. Hg vacuum.

The expected volumes of steam, soil vapors, and condensate passing through the condenser during the treatability study are summarized in Table 6. Once the treatment volume is completely heated, the VR system will capture approximately 330 scfm of steam and soil vapors from the subsurface. This combined flow will be composed of 200 scfm of steam and 130 scfm of soil vapors. Approximately 55,000 gallons of water will be removed from the subsurface during the remediation in the form of steam. This condensed water will be recycled for use as condenser recirculation cooling water and as electrode drip water.

The condenser is water-cooled, and the heat that is removed from the steam in condensation is reflected in a temperature rise of the recirculation cooling water. The heat is then removed from the recirculation water using a cooling tower in which a portion of the recirculation water evaporates with each pass. Operations of the cooling tower are very similar to that of an air-stripping tower. Condensate water is recycled to replenish the recirculation water lost to evaporation. Due to the energy balance, the amount of water that is evaporated from the cooling tower is almost exactly equal to the amount of steam that is condensed, with the exact balance depending on the atmosphere's relative humidity. During the day, when the relative humidity tends to be lower, the condenser evaporates a little more water than it condenses. During the

night, and during rainy periods, the condenser tends to condense a little more water than it evaporates.

Table 6. Estimated Flow Rates and Volumes of Steam and Condensate

Process Stream	Maximum Flow Rate [1]	Total Volume over the Entire heating Period
Combined Steam and Vapor Flow	330 scfm	NA
Steam from the Subsurface	200 scfm	NA
Air and Vapors from the Subsurface	130 scfm	NA
Water recovered from the subsurface	1.1 gpm	55,000 gallons
Notes: [1]Flow rates achievable when entire remediation volume is at design temperatures. NA = not applicable		

Steam extraction will remove groundwater from the subsurface at a rate of roughly 1.1 gallons per minute (gpm) when the site has reached the target temperature. Nearly the entire resulting condensate stream is evaporated to the atmosphere as condenser cooling tower makeup water. Any excess condensate will be used as electrode drip water or will be stored for disposal, while any shortage will be made up for with a potable water makeup supply.

Condensate collects in the condenser and is automatically pumped to the recirculation loop of the cooling tower. Prior to entering the cooling tower, excess condensate typically contains total VOCs at a concentration of less than 500 parts per billion (ppb). Once it enters the recirculation loop, the condensate makes hundreds of passes through the cooling tower and is air-stripped until it contains VOCs at non-detectable levels. Cooling tower VOC emissions make up less than 1% of the VOCs removed from the site and are described in section 8.3 below. Excess cooling tower is pumped to the onsite holding tank for storage and for use as make-up water for the cooling tower. Excess water remaining in the holding tank at the end of the remediation will be removed by vacuum truck and disposed of by PCI.

A potable water source is required to fill the condenser cooling tower at the start of operations and to serve as a makeup source during initial operations of the condenser. Prior to reaching significant steaming conditions in the subsurface, evaporation of the cooling water will occur. This evaporated water needs to be replaced to maintain proper levels in the cooling tower.

5.10 Electrode Drip System

The ERH system will use recirculation water as drip water to help control the electrical performance of the electrodes. The drip water sequence and duration is remotely operated by the systems control program. The volume of drip water re-injected into the subsurface from which it originated will be approximately ½ the volume removed as condensate maintaining a negative groundwater gradient and hydraulic control. Details of the water injection have been detailed in the provided water injection permit request *GRE06 Condensate Re introduction 040606 acf.*

5.11 Granular Activated Carbon Vessels

Two granular activated carbon (GAC) vessel will be maintained onsite during the remediation with one unit online and one as a spare. Each vessel will be rated for vacuums of up to 15 in. Hg and contain about 1,000 lbs of GAC. The online GAC vessel will be arranged in a single configuration with a vapor stream bypass. The vapor stream will be monitored weekly with laboratory samples and three times a week with a PID to monitor mass removal. When the vapor stream exceeds 6 lbs/hour of total VOC mass removal the GAC bypass will be closed forcing the vapor stream through the GAC for vapor treatment. The influent and effluent of the GAC will be monitored on the same sample schedule of weekly with laboratory analysis and three times a week with a PID. TRS will operate the vapor treatment system to maintain the emissions mass below 8 lbs/hour and will add or remove vessels to maintain sufficient vapor capture. When breakthrough has been observed in the GAC vessel it will be taken offline, the spare unit will become the new unit placed online for vapor treatment. Spent GAC vessels will be profiled by a grab sample and will be replaced or refilled to maintain at least one spare onsite. Once the peak extraction of VOCs has passed a spare GAC vessel may not be maintained. An air emission permit request has been submitted as *GRE06 Air Discharge Request 040506 acf.*

VOC breakthrough occurs when the GAC becomes saturated with VOCs – when further adsorption of the vessel is not possible. Breakthrough is defined as a GAC vessel outlet concentration that exceeds 50% of the inlet concentration. If GAC breakthrough is reached during the remediation:

- Electrical resistance heating will be stopped.
- Vapor recovery will be stopped and the primary GAC vessels will be taken off service.
- The secondary GAC vessels will be converted to primary GAC vessels and the spare vessels will be connected as new secondary GAC vessels.
- Vapor recovery and ERH operation will be resumed.

6.0 Operations and Maintenance

6.1 System Alarms

System diagnostics, controls and alarms are processed through the computer in the ERH PCU. Automatic notification of a process shutdown is relayed to operations staff via an automated phone dialer. Operators can remotely switch the ERH PCU on or off, change the voltages applied to the electrical phases, reset alarms, and record system operating data throughout the ERH remediation system. Voltage changes are made immediately and may be set to cycle up or down over set time intervals. Alarms are provided for open door indications, transformer over-temperature, over current trips and faults, and excessive phase current levels.

Operators can remotely determine if system faults or unwanted operating conditions exist at the PCU, vapor recovery equipment or the electrode field. Most faults and undesired operating conditions can be corrected remotely by altering operating parameters or can be tolerated until the next scheduled site visit. More severe system faults may require portions of the electrode field, or the entire ERH PCU, to be shut down. Most system alarms result in an immediate shut

down of the PCU and in some cases must be cleared by a site visit before the PCU can be re-energized. TRS will mobilize personnel as soon as possible to correct the cause of the system shutdown and return the system to normal operations.

Because steam collection is a vital operations function, system faults that do not originate in the ERH PCU are relayed to the VR blower causing the VR system to shutdown. If the VR system shuts down for any reason, the ERH PCU automatically shuts down and an auto-dialer contacts operations personnel.

If the ERH condenser is unable to process steam and condensate, a fault condition will result in a shutdown of the VR blower. This immediately stops steam collection and condensate production. Stopping the VR blower triggers a delayed shutdown of the ERH PCU and immediately initiates the automatic notification auto-dialer. The alarms for the ERH PCU, ERH condenser, VR blower, and the excess condensate holding tank along with the actions caused by each alarm are identified in Table 7.

Table 7. System Alarms and Actions

Condition	Alarm	Action
Generator power failure	PCU Stops VR blower stops Condenser stops Auto-dialer calls out	All equipment stops running Operations staff are notified Site visit may be required
Transformer over heating Blown fuse in ERH PCU ERH PCU failure or malfunction ERH PCU shutdown	ERH PCU Alarms ERH PCU stops VR remains operational Condenser remains operational	ERH PCU shuts down Site visit may be required to restart
Loss of an electrical phase Electrode malfunction or failure Electrode overheating	No Alarm VR remains operational Condenser remains operational	Problem seen in routine check Site visit may be required
Condenser power failure Condenser fan failure Condenser blower or pump failure High-High Level Alarms	Condenser Alarms VR blower stops Condenser stops Auto-dialer calls out	VR Blower shuts down ERH PCU shuts down Operations staff are notified Site visit is required to restart
VR blower power failure VR blower failure	VR blower stops Auto-dialer calls out	ERH PCU shuts down Operations staff are notified Site visit is required to restart

The following operational parameters will be measured during the remediation:

- power and energy input to the subsurface,
- thermal gradients throughout the treatment volume,
- rate and mass of CVOC recovery from the subsurface,
- rate and total volume of steam recovery from the subsurface
- volume of condensate production, and
- CVOC concentration in any discharged condensate.

6.2 ERH Performance Metrics

There are a number of criteria that may be used to evaluate the effective performance of the ERH process. The ultimate factor that determines success is the final reduction in soil contaminant concentration. Regardless of the status of all other criteria combined, reaching the target contaminant reduction goal renders the entire project a success. In addition to this metric, power application rates, total energy input to the subsurface, condensate production rates and totals, vapor stream contaminant concentration, and subsurface temperatures may all be used to measure progress in an ERH application. Of these additional metrics, the most important are temperature and power application rates.

Another performance criterion will be the amount of energy that is input into the subsurface. TRS anticipates that an average power application rate of 241kW will be input into the subsurface over the life of the project. This power application rate is anticipated to be sufficient to achieve the target heat-up rate described above, as well as the overall contaminant reduction goal.

Since the total mass of contaminant in the subsurface cannot be accurately quantified, nor specifically located, vapor stream concentrations cannot be accurately predicted for use as a progress metric.

In summary, two metrics will be used to monitor the ERH progress and performance until soil sampling is performed:

- heat up rates and temperatures across the site
    - **1 to 3 °C/day** within the actively heated zone(s) **up to about 90°C**

- average power application rates
    - **241 kW** over the life of the project

Again, the most important measure of project performance is soil CVOC concentration. Once average temperatures have reached 90°C, many portions of the site will have reached boiling. Therefore, the heat-up rate of 1 to 3°C will no longer be a realistic measure of performance.

TRS recommends several rounds of confirmatory soil sampling in order to save time, energy, and money. The first round of soil sampling will be conducted when the remediation approximately 70% complete. TRS expects that about 80% of the soil samples will meet the

remedial goal. TRS will then shut down the portions of the site that are clean and concentrate energy and efforts on those portions of the site that still contain significant contamination. Tetra Tech NUS will conduct a second round of soil sampling when the project is complete. If any soil samples fail to meet the goal then a third round of soil sampling will be scheduled.

TRS reserves the right to modify the operational configuration of the system to focus power and energy to areas of the site where it will do the most good (i.e., the regions that contain the greatest residual contamination). At this point in the remediation, power application rates may decrease as power and energy are focused on those areas that need it most, and soil and groundwater concentrations will become the measure of progress.

6.3 Site Security and Fencing

The equipment compound is contained within a 6-foot chain-link fence with a privacy curtain. "DANGER - HIGH VOLTAGE" signs will be prominently displayed along the perimeter of the equipment compound and treatment area. Additional security is provided for the ERH PCU via key-lock doors on the PCU enclosure. The posts of the fence will be embedded into the ground but not set in concrete. The average spacing between the electrodes and fence will be approximately 15 feet. The post installed along Sampson Street will be within a few feet of the H row electrodes and will be covered with PVC oversleeves to prevent any contact to a potential electrical conductor. The fence will be installed by a National Fence, a facility approved private fencing contractor.

7.0 System Operations

System installation will require approximately 3-4 weeks and will involve standard subsurface drilling and construction activities. Once the electrodes and TMPs are in place, activities will include preparation and piping of the condenser and VR systems. Simultaneously, the ERH PCU and the data acquisition system will be prepared for operation. The final steps in system installation include the connection of electrical power, control wiring, and system interlocks.

Before energy is first applied to the subsurface, the ERH condenser and VR systems are made operational and optimized. Next, the activities in Section I of the ERH Start-Up Check List presented in Appendix B are completed. Finally, all system interlocks are tested to verify proper operation.

Complete start-up and optimization of the VR and ERH system takes one to two weeks. ERH start-up is initiated by establishing a personnel exclusion zone around the electrode field and energizing the electrodes at a low applied voltage. With the field energized, operating parameters in the ERH PCU are compared against known standards and a step-touch voltage survey is completed throughout the area overlying and surrounding the treatment zone. In recording step-touch potentials, attention is taken to make extra readings at locations where objects that could carry induced voltage extend from the subsurface.

If all operating conditions are within accepted standards, the voltage to the electrode field is slowly increased. With each significant increase in applied voltage, operating parameters are reviewed and a step-touch voltage survey is performed. If operating conditions are not within accepted limits, changes are made to the system configuration until they are once again acceptable. This iterative process can take several days before the full design voltage is applied to the field for extended periods.

Once power application levels have reached optimum conditions, the activities in Part II of the ERH Start-Up Check List are completed to establish that the system is ready for unattended operations. During this process, operations of the ERH PCU are observed while optimum voltage is applied to the electrode field. Remote capabilities of the PCU and data acquisition system are then verified.

Once the site has been cleared for unattended operations, the system can be monitored and controlled remotely by TRS operations staff. Routine site visits are conducted to perform site checks, equipment maintenance, system optimization tasks, and scheduled measurements and sampling activities. As necessary, unscheduled site visits are made to respond to variances in operating parameters and system alarms.

Following ERH system shutdown, TRS will provide a draft final Remedial Action report within 14 days that summarizes the following elements:

- ERH treatment system as-built drawings,
- Operating parameters, including total energy input, and temperature,
- Treatment duration,
- Contaminant mass removed,
- Soil concentrations achieved, and
- Metrics achieved or not achieved.

8.0 Contingency Planning

As part of contingency planning, TRS will provide Navy personnel with training on proper system shut down procedures.

8.1 Power and Mechanical Failures

In the event of a utility power failure, all system equipment will shut down and the auto-dialer will contact operations staff using an emergency battery pack for power. A site visit is required to clear all alarms, restart the VR blower, and restart the operations computer before the ERH PCU can be re-energized.

Fuse or breakers protect each major electrical component used in the remediation system from severe damage in the event of electrical surges. Larger electrical motors are further protected from overheating by automatic thermistors that trigger automatic shutdowns of the motor if normal operating temperatures are exceeded. The common causes of shutdown for each piece of equipment used in the remediation system are listed in Table 8.

Table 8. Common Causes of Equipment Shutdown

Equipment	Causes of Operating Shutdowns
ERH PCU	Power failure and blown fuses Internal transformer fault condition VR blower stops
VR Blower	Power failure and blown fuses Internal blower fault conditions Mechanical failures (belts/bearings) Condenser malfunction
ERH Condenser	Power Failure and blown fuses Internal condenser fault conditions Mechanical failures (belts/bearings)

Each piece of equipment is provided with the level of protection from power failure and electrical surges required by the National Electrical Code and the equipment manufacturer. The equipment alarm and control wiring systems are designed to ensure that equipment shutdowns will not result in operating conditions that pose a risk to human health or the environment.

If a fault or alarm causes the ERH PCU to shut down, the creation of steam in the subsurface stops immediately. However, residual steam remains in the subsurface and that steam may slowly spread by diffusion to unheated vadose zone region in shallow soils above the treatment zone. As the steam encounters cool soils, it condenses before traveling more than a few feet. This condensate will be remediated by the VR system once operations are restarted.

8.2 Storms and Lightning

The ERH PCU is grounded per National Electrical Code requirements for a strike by lightning. Additionally, fuse protection is provided throughout the ERH PCU and supporting pieces of equipment.

Even though most of the treatment area is covered, during a very severe storm the shallow vadose zone may become temporarily flooded by surface water. The VR and condenser systems are designed to accept some extracted groundwater from the subsurface. At full steaming, the capabilities of the extraction systems will be less than one-third utilized by the 1.1 gpm of groundwater being removed from the subsurface as steam. If the storm is not overly severe, the extraction system will be able to keep up with the surface water infiltration and normal operations will continue. If surface water infiltration overcomes the extraction system, level alarms in the condenser will trigger a shutdown of the VR blower, which will shut down the ERH PCU. A site visit will be required to clear the alarms and restore the system to operation.

8.3 Condenser Cooling Tower Emissions

At the start of the remediation, the condenser cooling tower is filled with potable water. During the remediation, this water level is maintained primarily with condensate. A makeup water source, in addition to condensate, is also required as a backup supply, mainly to keep the cooling tower full during the period before the site reaches full steaming conditions. Condensate added to the cooling water loop is air stripped of VOCs inside the cooling tower. Vapors from the condenser cooling tower do not require treatment prior to release to the atmosphere even when condensate is the primary makeup water source as described below.

8.4 Secondary Containment

Secondary containment is not provided for the VR piping or the ERH condenser. When the entire remediation volume is at boiling, the VR lines hold less than 2 gallons of groundwater in the form of water droplets and steam. During operations, these lines are under vacuum and a line rupture will not result in the venting of steam.

A worse case scenario is the loss of vacuum in the lines during steaming, either by design or an accidental shutdown. In either case, steam in the lines will condense to form less than 2 gallons of condensate. This condensate will remain in the lines or flow back to into the subsurface. Any VOCs in the condensate flowing back into the subsurface will be remediated by the system once it is restarted.

Once created in the condenser, up to 120 gallons of condensate is stored under vacuum until high level switches turn on the condensate pump. Condensate is then automatically pumped to the make-up water tank and then to the condenser cooling tower water recycle loop as make-up water. If a leak were to occur in the cooling water recycle loop, the spill would be a mixture of potable water and treated condensate. All water levels are maintained automatically through the use of level switches, float valves, solenoid valves, and pumps.

If excessive condensate collects in the condenser due to failure of the condensate pumping system, a high-high level switch is activated, automatically shutting down the vapor extraction blower. This action immediately stops the flow of steam into the condenser, provides a delayed shut down of the ERH PCU, stops the application of electrical energy to the subsurface, and automatically notifies the operations staff.

8.4 System Noise Compliance

The ERH system operates on a 100% duty cycle and must maintain a maximum sound output of 60 db. The noise receptors from which the system will be monitored are the fire station to the east, the southeastern barracks and the administrative building to the south. Measures have been implemented into the system design, such as sound enclosures and multiple piping silencers to control noise production. During the shakedown/startup phase of the project the sound production of the system will be monitored for the designated noise receptors. Each component will be isolated and then operated together to identify noise producers that require addition sound controls before the system is allowed to operate at a constant state.

9.0 Sampling and Monitoring

9.1 Sampling and Monitoring Strategy

The effectiveness of the ERH remediation will be evaluated by monitoring the reduction of PCE, TCE, DCE, and VC concentrations in the site soil. Additional sampling and monitoring will be performed during the course of the project to track the progress of the remediation, to support operational decisions, and to manage waste streams. Sampling and monitoring will be performed in three phases: pre-heating baseline sampling, sampling and monitoring during operations, and post-heating sampling. Chemical analytes will be sampled from soil, the recovered soil vapor stream and the vapor treatment GAC. Detailed sampling procedures for the vapor stream have been included in the provided sampling and analysis plan.

9.2 Vapor Samples and Mass Removal

A recovered vapor sample will be collected weekly by TRS and analyzed for CVOC (EPA 8260) concentrations to provide a determination of the mass extraction rate of the ERH process and to help determine when soil samples should be collected for confirmation purposes. This sample will be collected via bag samples on a weekly basis until the peak VOC extraction rate has occurred, and then collected every two weeks thereafter. In order to use the vapor information for system optimization, the sample analysis turnaround time will be 4 days or less during weekly monitoring, then 1-week for bi-weekly monitoring.

The mass removal will be determined by multiplying the mass extraction rate between two sample points by the time between the two sample points. The mass removal rate will be averaged between the beginning and end of each time period. Any downtime for the vapor recovery blower will not be counted in the total. The equation used for the mass extraction rate is listed below:

Equation: Contaminant mass removal rate (lbs/day)=(85% x Flow rate FPM x Pipe size sqft.) x (Concentration ppmv/Conversion factor 1) x Conversion factor 2

Conversion factor 1 adjusts the mass for the individual constituent to compensate for its specific gravity, listed below
PCE=148 TCE=186 cis-1,2 DCE=253 VC=392

Conversion factor 2 is equal to 0.0898 and accounts for the following unit changes (milligrams→lbs, minutes→days, liters→cf) 1440*28.317/453593=.0898

The inner pipe diameter of Schedule 40 PVC sample location is 3.042-inches with a cross-sectional surface area of 0.0505-sqft.

9.3 Post- Remediation Sampling

After shutdown of the ERH system, confirmatory soil samples will be collected from the baseline borings and analyzed for CVOC concentrations. Results of these analyses will be compared to baseline concentrations and percent VOC concentration reductions calculated. The remedial goal for soil is to reduce CVOC concentrations to below 20 mg/kg.

9.4 Operational Monitoring

Several parameters will be measured during the operation of the ERH system to support an assessment of the effects of heating on selected properties of soil and CVOCs. Records of applied power and mass of contaminants and water removed are essential to the assessment of system performance. Measurement of condensate volume, applied/derived vacuum, and temperature can be used to assess the changing properties of the soil and CVOCs during the remediation.

Plots of applied power versus time, both as power use in kilowatts, and cumulative energy applied to the soil as kilowatt-hours, will be used to show trends during the operation period. These trends will be compared to changes in the CVOC removal rate, by graphing pounds of contaminant removal versus time, to monitor the performance of the treatability study. The trends of these parameters over time will be a key measure of the progress of the ERH system operations.

The primary means to assess the thermal performance of the study will be a plot of temperature versus time and versus depth at the three TMP locations.

9.5 Subsurface Temperature Monitoring

The ERH heating process is tracked by monitoring the operating parameters of the ERH PCU and subsurface temperatures. Thermocouples will be located in monitoring strings installed vertically into the subsurface at the three TMP locations. Each TMP will contain multiple thermocouples located at five-foot intervals. Thermocouples will be monitored continuously using the ERH control system and temperature profiles will be produced to show temperature versus time and temperature versus depth bgs.

9.6 Operational Reporting

ERH monitoring information as well as observations and suggestions for the project will be submitted to the client as part of a weekly report.

10.0 Subcontractors

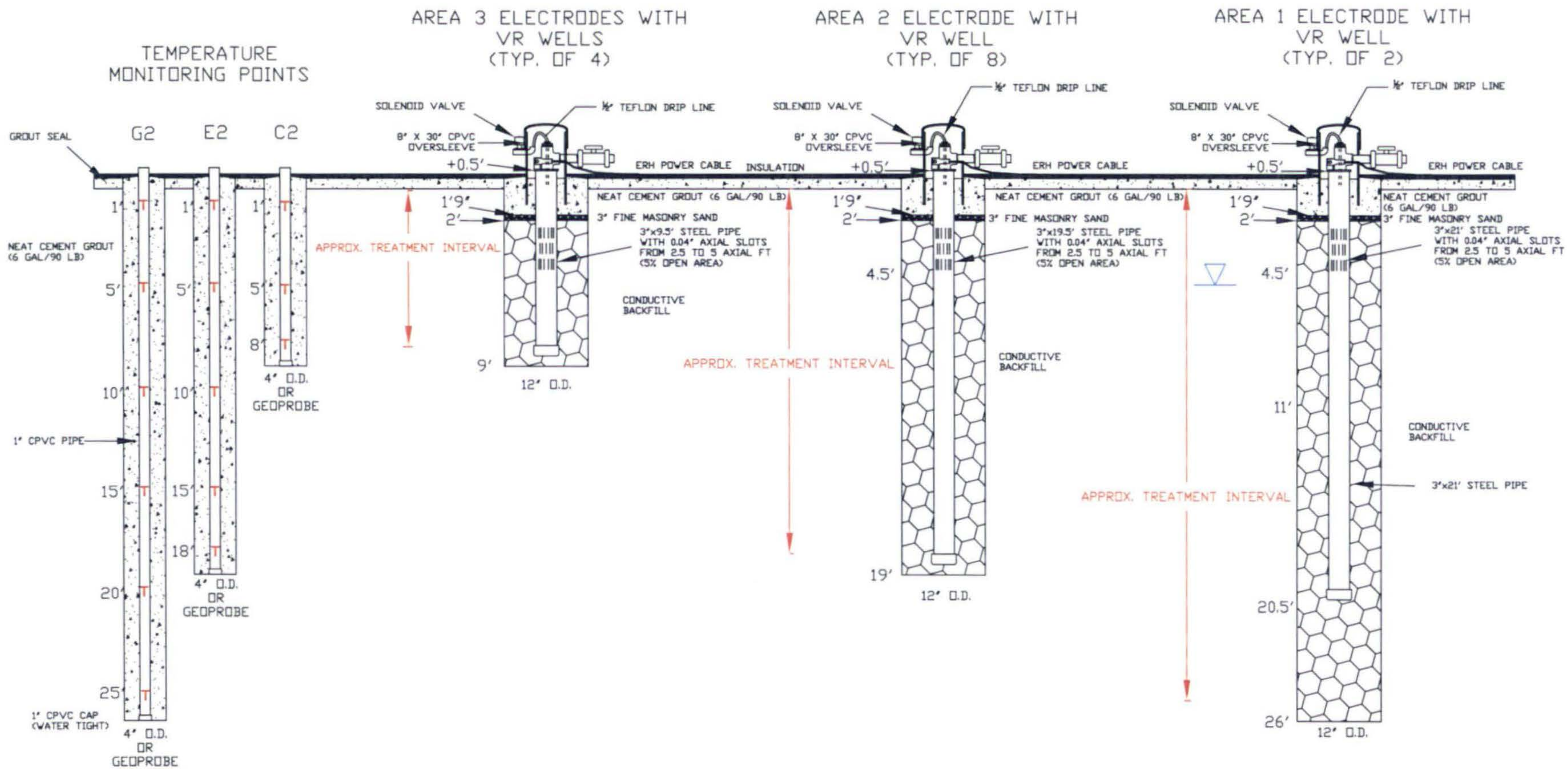
Two subcontractors will perform work onsite on behalf of TRS to install various portions of the ERH system. A fencing contractor will install an exclusion fence using embedded posts, chain link and privacy curtain. The primary electrical service will also be provided by a local electrical

subcontractor with a current Illinois electrician's license. Table 9 below, lists each subcontractor's information with their insurance certificates included as Attachments C-1 and C-2

Table 9. Subcontractor List

Name	Task	Contact Person	Phone	License
Aldridge Electrical, Inc.	Primary Electrical Service	Dan Vetter	(847) 680-5200	Electrician's License# C41951
National Construction Rentals	Security Fence	Debbie Swetin	(630) 499-6848	Illinois BL# 23289201

Appendix A – System Drawings



T = THERMOCOUPLE (INSTALLED AFTER DRILLING IS COMPLETE)

THERMAL REMEDIATION services inc.

CONFIDENTIAL

REVISION REFERENCE NO	DRAWING TITLE	DESCRIPTION	REV
DCR-GRE06-03	GRE06-ED-01	REVISED BASED ON DESIGN REVIEW	0
DCR-GRE06-02	GRE06-ED-01	SENT TO CLIENT	A

REFERENCE DRAWINGS — REVISIONS

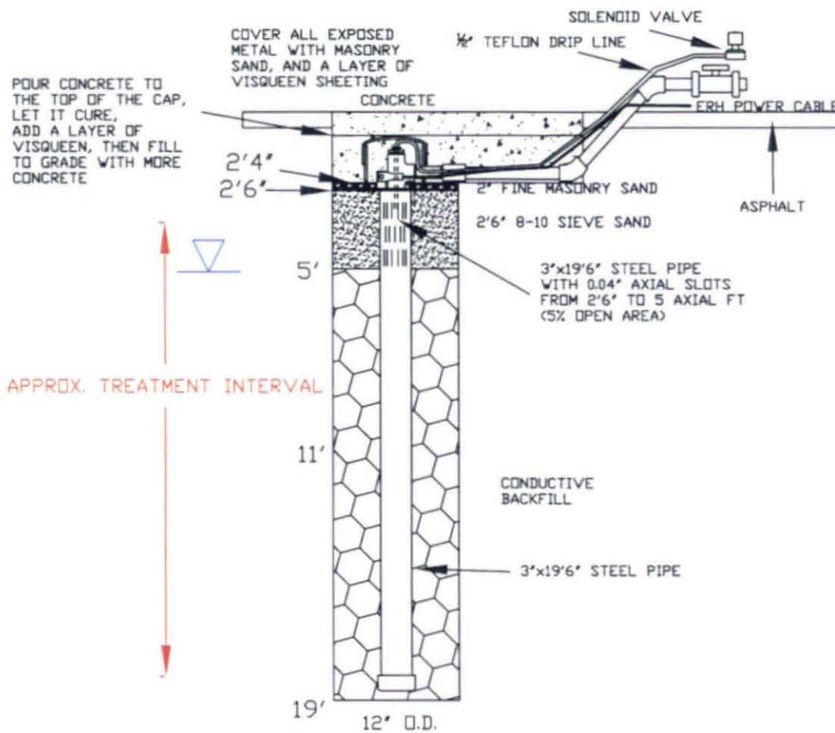
DATE 3-31-06 — CADFILE EVED6 ED

DRAWN C CROWNOVER 3-8-06
ENGR C CROWNOVER 3-8-06
PROJECT MANAGER C BLUNDY

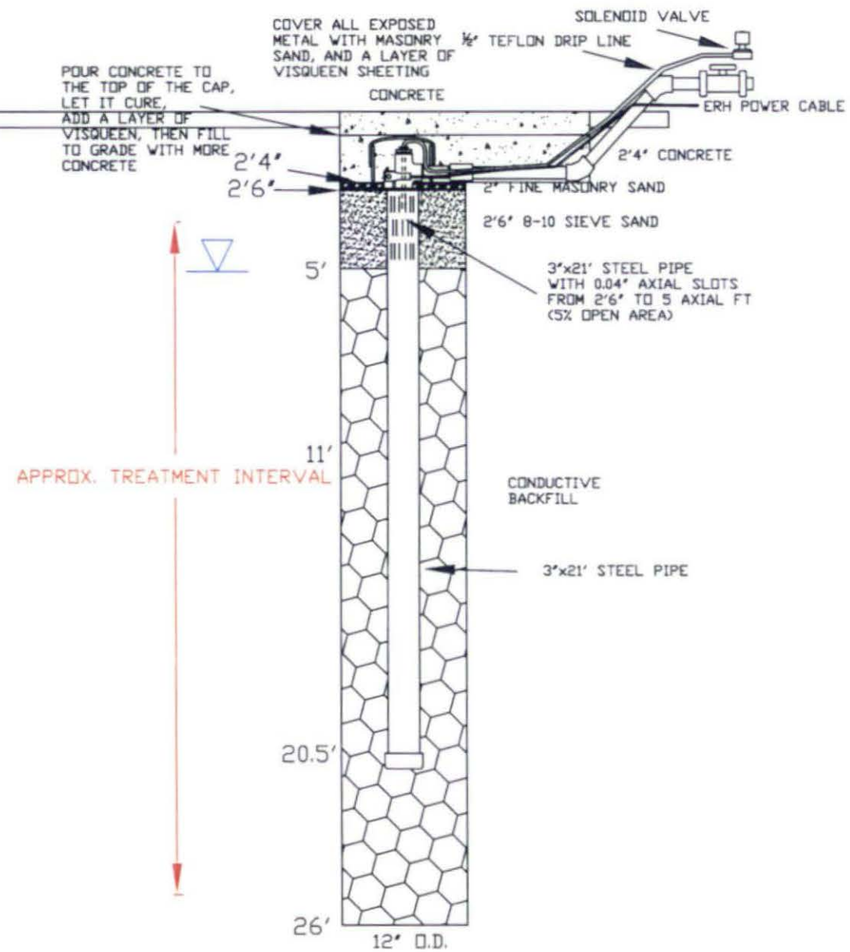
GRE06
ELECTRODE DETAILS
GREAT LAKES, ILLINOIS

SCALE NONE — SHEET 1 OF 2
DWG NO GRE06-ED-01 — REV 1

AREA 2 ELECTRODE WITH VR WELL (TYP. OF 1)



AREA 1 ELECTRODE WITH VR WELL (TYP. OF 1)



THERMAL REMEDIATION services inc.

REVISION REFERENCE NO	DRAWING TITLE	DES	MAT	QA BY / DATE	ENGR BY / DATE	CHK BY / DATE	REV BY / DATE	DESCRIPTION	NO
DCR-GRE06-03	GRE06-ED-01							ELECTRODES MOVED INTO ROAD SUBSURFACE COMPLETION	

REFERENCE DRAWINGS — DATED: 4-21-06

REVISIONS — CADFILE EVE06 ED

DRAWN	C. CROWNOVER	4-0-08
CHECKED		
DATA INPUT		
ENGR	C. CROWNOVER	4-0-08
PROJECT MANAGER	C. BLUNDY	
DESIGN		
QA		

APPROVED FOR IMPLEMENTATION — BY ____ FOR ____ DATE ____

GRE06

ELECTRODE DETAILS

GREAT LAKES, ILLINOIS

SCALE: NONE — SHEET NO. 2 — SHEETS 2

DRAWING NO. GRE06-ED-01 — REV NO. 1

Approximate Extent of Strong ERH Treatment (2500 sq.ft.)

Steam Line

Trench

N

G2

G3

G4

G5

H3

H4

A

B

F2

E2

F3

D2

C2

E3

B2

D3

F4

E4

0 Scale in Feet 10

VR Blower

Holding Tank

Stack

Power Control Unit

Condenser

Transformer

Cooling Tower

GAC

Sidewalk

Grass

THERMAL REMEDIATION services inc.

CONFIDENTIAL

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REVISION REFERENCE NO	DRAWING TITLE	DESCRIPTION
DCR-GRE06-03	GRE06	SITE VISIT
DCR-GRE06-02	GRE06	SENT TO CLIENT
DCR-GRE06-01	GRE06	SENT TO CLIENT

REFERENCE DRAWINGS

DATE: 4-21-06

REVISIONS

DWGFILE GRE06 PP 031706 cld

DRAWN C CROWNOVER 3/17/06

CHECKED

DPM APVD

ENGR C CROWNOVER 3/17/06

PROJECT MANAGER C BLUNDY

OTHER

QA

APPROVED FOR IMPLEMENTATION

BY

FOR DATE

GRE06

PLOT PLAN

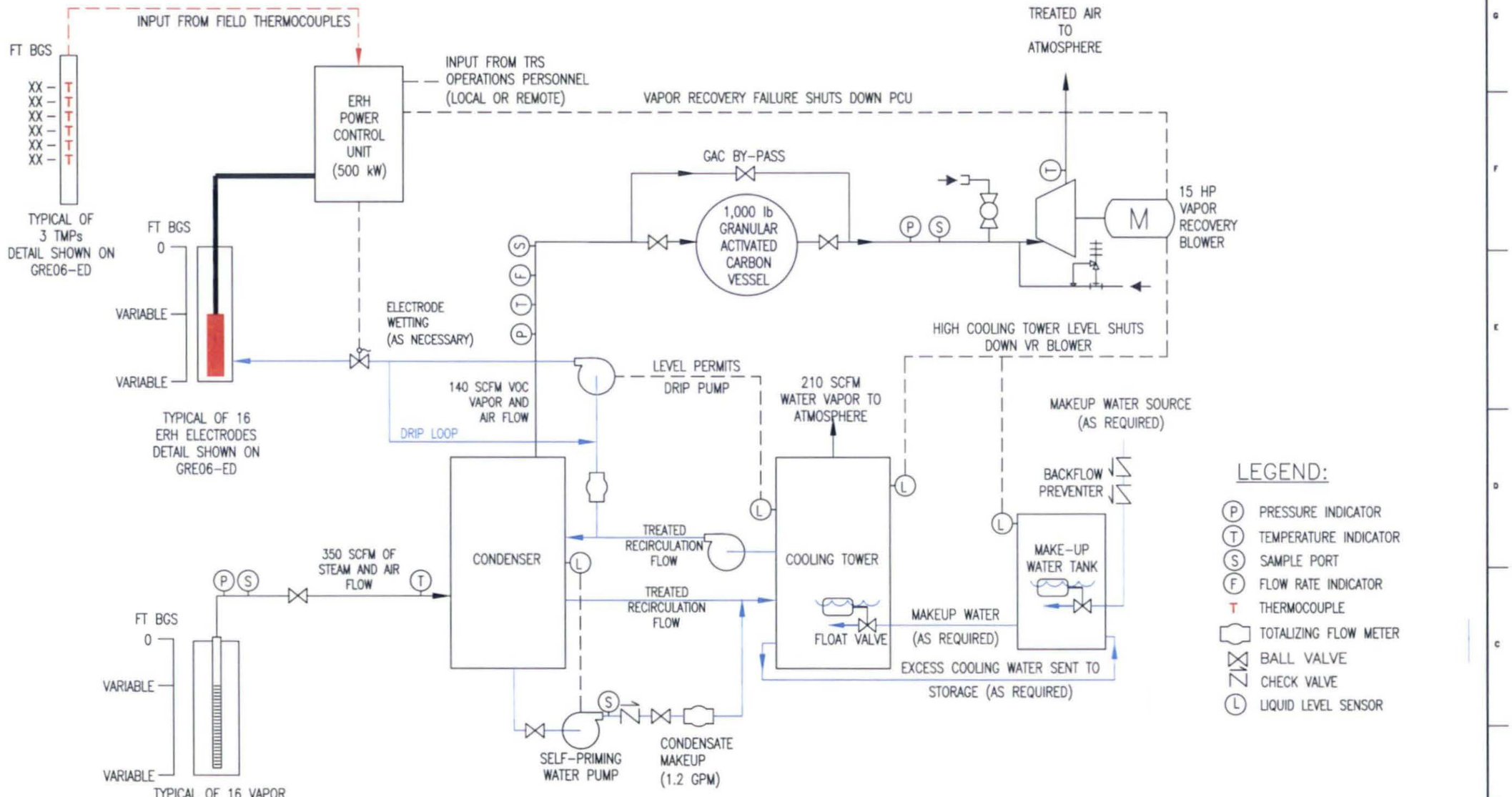
GREAT LAKES, ILLINOIS

SCALE NONE

SHEET NO 1 OF 2

DWG NO GRE06 PP

REV 1A



THERMAL REMEDIATION services inc.

REFERENCE DRAWINGS		REVISIONS								
DCR–GRE06–02	GRE06 PFD							SENT TO CLIENT	0	C. CROWNOVER 3/17/06
DCR–GRE06–01	GRE06 PFD				3/17/06		3/17/06	PROJECT START	A	C. CROWNOVER 3/17/06
					3/17/06		3/17/06			C. BLUNDY
REVISION REFERENCE NO	DRAWING TITLE	DR	MF	QA BY / DATE	DRAW BY / DATE	CHK BY / DATE	REV BY / DATE	DESCRIPTION	REV NO	QA

DATE: 3/17/06 — CADFILE GRE06 PFD

APPROVED FOR IMPLEMENTATION — BY — FOR — DATE

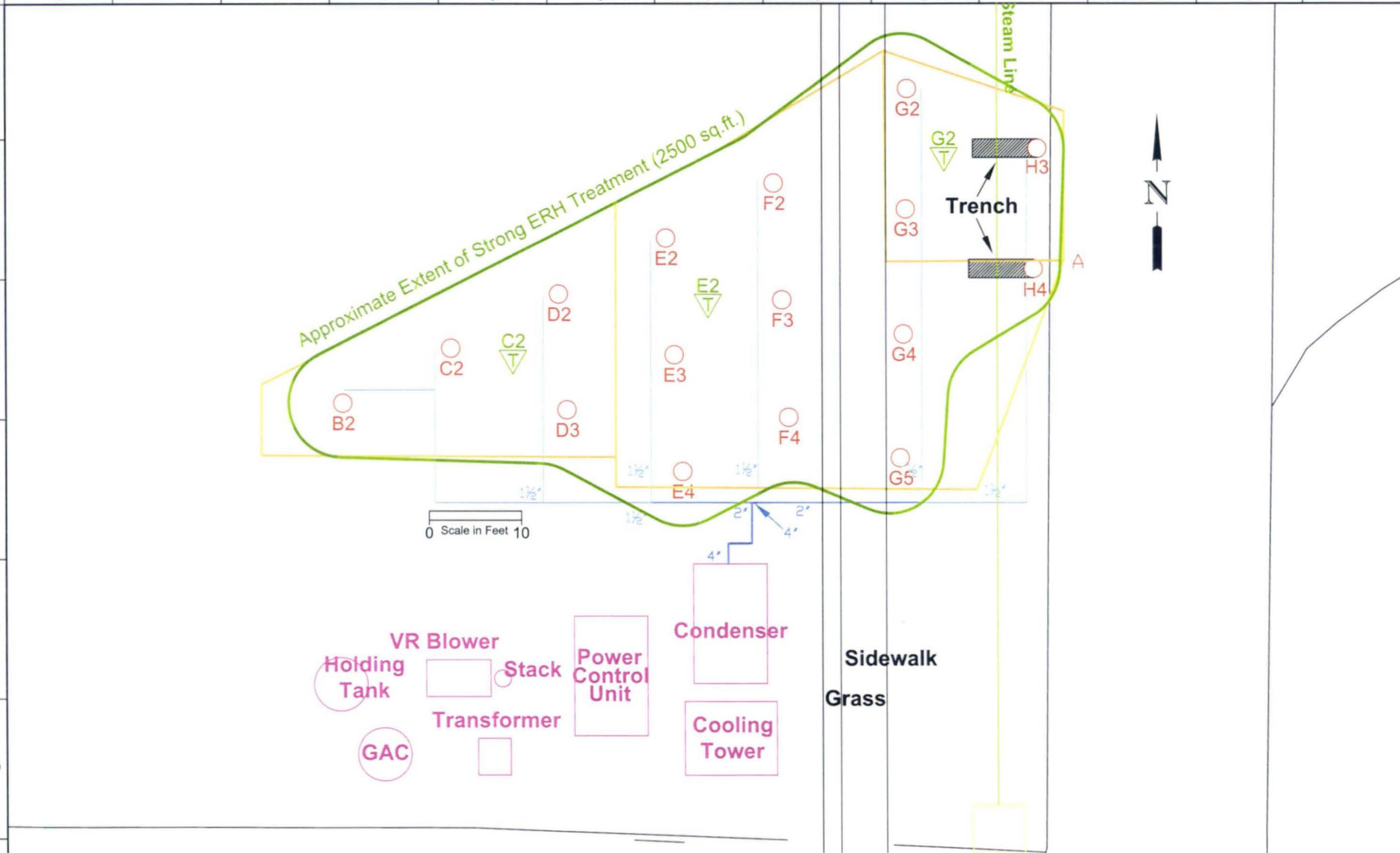
GRE06

PROCESS FLOW DIAGRAM

GREAT LAKES, ILLINOIS

SCALE NONE — SHEET NO 1 — SHEET NO 1

DRAWING NO GRE06–PFD — REV NO 1



THERMAL REMEDIATION services inc.

Revision Reference No	Drawing Title	Description	Rev
DCR-GRE06-03	GRE06	SITE VISIT	1
DCR-GRE06-02	GRE06	SENT TO CLIENT	0A
DCR-GRE06-01	GRE06	SENT TO CLIENT	0

REFERENCE DRAWINGS — REVISIONS

DATE: 4-21-06 — CADFILE GRE06 PP

DRAWN C. CROWNOVER
ENGR C. CROWNOVER
PROJECT MANAGER C. BLUNDY

GRE06

PLOT PLAN (VR PIPING)

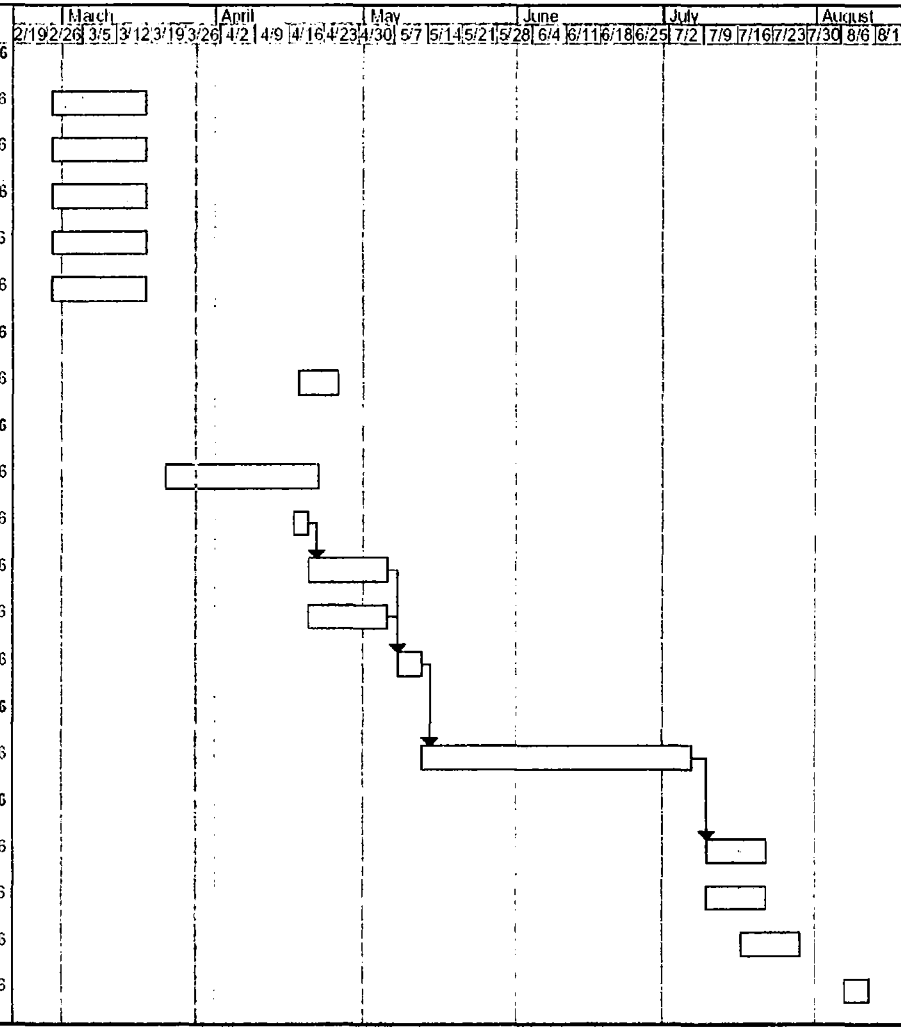
GREAT LAKES, ILLINOIS

SCALE NONE — SHEET 2 OF 2

DWG NO GRE06 PP — REV 1A

ERH Project Schedule
Treatability Study
Site 22, Naval Station Great Lakes, IL

ID	Task Name	Start	Finish
1	**Design, Work Plans, Permits**	**Mon 2/27/06**	**Fri 3/17/06**
2	Plot Plan	Mon 2/27/06	Fri 3/17/06
3	Electrode	Mon 2/27/06	Fri 3/17/06
4	TMP/MW	Mon 2/27/06	Fri 3/17/06
5	P&ID	Mon 2/27/06	Fri 3/17/06
6	Equipment Layout	Mon 2/27/06	Fri 3/17/06
7	**Subsurface Installation:**	**Tue 4/18/06**	**Tue 4/25/06**
8	Subsurface Installation:	Tue 4/18/06	Tue 4/25/06
9	**Surface Installation & Start-up:**	**Wed 3/22/06**	**Fri 5/12/06**
10	Electrical Service	Wed 3/22/06	Fri 4/21/06
11	Mobilization	Mon 4/17/06	Wed 4/19/06
12	ERH System Construction and Set-up	Thu 4/20/06	Fri 5/5/06
13	VR System Construction and Set-up	Thu 4/20/06	Fri 5/5/06
14	Start-up	Mon 5/8/06	Fri 5/12/06
15	**System Operation:**	**Sat 5/13/06**	**Thu 7/6/06**
16	System Operation:	Sat 5/13/06	Thu 7/6/06
17	**Demobilization & Report:**	**Mon 7/10/06**	**Fri 8/11/06**
18	Soil Sampling and Demobilization	Mon 7/10/06	Fri 7/21/06
19	Site Restoration	Mon 7/10/06	Fri 7/21/06
20	Draft Report	Mon 7/17/06	Fri 7/28/06
21	Final Report	Mon 8/7/06	Fri 8/11/06



THERMAL REMEDIATION services inc.

Project: GRE06 Schedule
Date: Tue 3/28/06

Task

Appendix B
Start-up Checklist

Site: _____ **Project Number:** _____

Section 1. To be completed prior to first application of power:

What is the expected electrode voltage? _____

What is the voltage rating of the cables? _____

What is the electrode spacing? _____

What is the electrode diameter? _____

What is the electrode conductive interval? _____

List and describe all subsurface conductive materials that pass through the field: _____

_____

_____

_____

_____

How is the ERH system grounded? _____

_____

_____

☐ Are there ground rods? _____

Distance from field? _____

☐ Is the current to ground monitored?

☐ Is there an automatic ERH shutdown for excessive ground current?

What is the shutdown setpoint? _____

☐ Is there a surface exclusion zone?

☐ Have personnel who will enter the exclusion zone signed the acknowledgement?

☐ Is there a personnel exclusion fence?

☐ Does the fence have barbed wire?

☐ Does the fence have embedded posts?

☐ Is the fence connected to utility ground?

☐ Are there "Danger - High Voltage" signs posted?

☐ Are these signs at 20 foot spacing on all sides?

☐ Does a fence separate the equipment from the field?

☐ Does this fence have an interlocked access gate?

☐ Does the fence have a surface grid?

What is the grid material?

☐ Is the fence connected to the grid?

At what interval?

Site: _____ **Project Number:** _____

- [ ] Is the grid covered?
  - What is the grid covered with? _____
- [ ] Are there boundaries of the exclusion zone that use existing fences/walls?
  - Describe these fences/walls: _____
- [ ] Are the electrode heads insulated?
  - Describe the electrode head insulation: _____
- [ ] Is any part of the field not covered by an exclusion zone?
- [ ] Is there a subsurface neutral zone?
  - What depth interval is the neutral zone? _____
  - What is the depth to water? _____
  - What is the depth to known utilities? _____
  - What is the neutral zone material? _____
  - What gauge is the neutral wire? _____
  - [ ] Is the neutral connected to utility ground? (not recommended)
    - [ ] Is the amperage to ground monitored?
- [ ] Is there a surface grid?
  - What is the grid material? _____
  - [ ] Is the grid connected to all vaults or other surface metal?
  - [ ] Is the grid covered?
    - What is the grid covered with? _____
- [ ] Are there electrode vaults?
  - [ ] Do the vaults lock?
  - [ ] Are the vaults connected to utility ground?
  - [ ] Can the vaults flood?
  - [ ] Are the electrodes insulated?
  - [ ] Is a "Danger - High Voltage" sign in each vault?
- [ ] Are there any monitor wells in the field?
  - What material are the monitor well casings? _____
  - [ ] Are the monitor wells in vaults?
    - [ ] Are the vaults locked?
    - [ ] Are the vaults connected to the surface grid or utility ground?
  - [ ] Is a "Danger - High Voltage" sign in each vault or on each well?
  - [ ] Has the company responsible for monitoring been notified of danger by letter?
    - Date of letter: _____
- [ ] Are there "Danger - Buried High Voltage" signs?
  - [ ] Are these signs at 50' spacing?
- [ ] Has the property owner been notified of subsurface voltage by letter?
  - Date of letter: _____
- [ ] Is the site open to the public?

Site: _____ **Project Number:** _____

The site is ready for the application of power.

_____ _____

Project Leader date Reviewer

Date that a copy was sent to Operations VP. _____

Section 2. To be completed prior to first unattended operation:

What is the typical electrode voltage? _____

How long as the system been operating at this voltage? _____

What is the amperage to ground? _____

What is the highest observed amperage in a neutral wire? _____

What is the voltage from neutral to ground? _____

☐ Has a step-and-touch voltage survey log sheet been prepared?
☐ Does the log sheet refer to a plot plan that shows measurement locations?
(attached copy shows survey results)
☐ Has a voltage to utility ground survey been conducted?
(attached copy shows survey results)

Describe any anomalous measurements (electrodes with high or low currents, unusual voltages, etc.)

_____

_____

_____

What changes were made is response to the anomalies? _____

_____

_____

_____

(attach a copy of the post-change voltage survey)

The site is ready for unattended operation.

_____ _____

Project Leader date Reviewer

Date that a copy was sent to Operations VP: _____

Attachment C-Insurance Certificates

04/10/06 15:55 FAX 6302458010 WEIBLE & CAHILL 002

ACORD. CERTIFICATE OF LIABILITY INSURANCE OP ID MS ALDRI-1 DATE (MM/DD/YYYY) 04/10/06

PRODUCER
Weible & Cahill
2300 Cabot Drive, Suite 100
Lisle IL 60532
Phone: 630-245-4600 Fax: 630-245-4601

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURERS AFFORDING COVERAGE | NAIC #
INSURER A: Zurich Insurance Company
INSURER B:
INSURER C:
INSURER D:
INSURER E:

INSURED
Aldridge Electric, Inc.
20572 North Bradley Road
Libertyville IL 60048

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	ADD'L INSRD	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
A	X	GENERAL LIABILITY X COMMERCIAL GENERAL LIABILITY CLAIMS MADE [X] OCCUR X Blkt Addtl Insd X XCU Included GEN'L AGGREGATE LIMIT APPLIES PER: POLICY [X] PRO-JECT LOC	GLO534507901	03/31/06	03/31/07	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 2,000,000 $ 100,000 $ 5,000 $ 2,000,000 $ 4,000,000 $ 4,000,000
A		AUTOMOBILE LIABILITY X ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS X HIRED AUTOS X NON-OWNED AUTOS	BAP534507801	03/31/06	03/31/07	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1,000,000 $ $ $
		GARAGE LIABILITY ANY AUTO				AUTO ONLY - EA ACCIDENT OTHER THAN AUTO ONLY: EA ACC AGG	$ $ $
A		EXCESS/UMBRELLA LIABILITY X OCCUR CLAIMS MADE DEDUCTIBLE X RETENTION $ 0	AUC930357403	03/31/06	03/31/07	EACH OCCURRENCE AGGREGATE	$ 1,000,000 $ 1,000,000 $ $ $
A		WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? If yes, describe under SPECIAL PROVISIONS below	WC534508001	03/31/06	03/31/07	X WC STATU-TORY LIMITS OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	$ 1,000,000 $ 1,000,000 $ 1,000,000
		OTHER					

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES / EXCLUSIONS ADDED BY ENDORSEMENT / SPECIAL PROVISIONS
Re: Aldridge Job #275008-001, Installation of 500 kVA Service at Great Lakes Naval Station, Great Lakes, IL
Additional Insureds on General Liability: Thermal Remediation Services and Department of the Navy

CERTIFICATE HOLDER
TERM-7
Thermal Remediation Services
1755 Afton Avenue
Charleston SC 29407

CANCELLATION
SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.
AUTHORIZED REPRESENTATIVE
Molly M. Moran

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ACORD CERTIFICATE OF LIABILITY INSURANCE

Page 1 of 2

DATE (MM/DD/YYYY) 04/11/2006

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877-945-7378 Willis North America, Inc. - Regional Cert Center 26 Century Blvd. P. O. Box 305191 Nashville, TN 372305191	INSURERS AFFORDING COVERAGE	NAIC#
INSURED National Construction Rentals, Inc. 15319 Chatsworth Street Mission Hills, CA 91345	INSURER A: Travelers Property Casualty Company of Am	25674-006
	INSURER B:	
	INSURER C:	
	INSURER D:	
	INSURER E:	

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	ADD'L INSRD	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
		GENERAL LIABILITY				EACH OCCURRENCE	$
		☐ COMMERCIAL GENERAL LIABILITY				DAMAGE TO RENTED PREMISES (Ea occurrence)	$
		☐ CLAIMS MADE ☐ OCCUR				MED EXP (Any one person)	$
						PERSONAL & ADV INJURY	$
		GEN'L AGGREGATE LIMIT APPLIES PER				GENERAL AGGREGATE	$
		☐ POLICY ☐ PRO-JECT ☐ LOC				PRODUCTS - COMP/OP AGG	$
		AUTOMOBILE LIABILITY				COMBINED SINGLE LIMIT (Ea accident)	$
		☐ ANY AUTO				BODILY INJURY (Per person)	$
		☐ ALL OWNED AUTOS				BODILY INJURY (Per accident)	$
		☐ SCHEDULED AUTOS				PROPERTY DAMAGE (Per accident)	$
		☐ HIRED AUTOS					
		☐ NON-OWNED AUTOS					
		GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
		☐ ANY AUTO				OTHER THAN AUTO ONLY: EA ACC	$
						AUTO ONLY: AGG	$
		Excess LIABILITY				EACH OCCURRENCE	$
		☐ OCCUR ☐ CLAIMS MADE				AGGREGATE	$
							$
		☐ DEDUCTIBLE					$
		☐ RETENTION $					$
A		WORKERS COMPENSATION AND EMPLOYERS' LIABILITY	UB-419J522-8-05	5/1/2005	5/1/2006	☐ WC STATU-TORY LIMITS ☐ OTH-ER	
A		ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED?	UB-419J201-7-05	5/1/2005	5/1/2006	E.L. EACH ACCIDENT	$ 1,000,000
		If yes, describe under SPECIAL PROVISIONS below				E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
						E.L. DISEASE - POLICY LIMIT	$ 1,000,000
		OTHER					

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS

CERTIFICATE HOLDER

Thermal Remediation Services, Inc.
Attn: Brad Pierce
2325 Hudson Street
Longview, WA 98632

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

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